



**BROS PHASE 2 RI/FS
FIELD OPERATIONS PLAN
QUALITY ASSURANCE PROJECT PLAN**

**Bridgeport Rental and Oil Services Site
Logan Township, New Jersey**

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BROS Technical Committee

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Document Submission Sheet

Phase 2 RI/FS Quality Assurance Project Plan

Roux Associates, Inc. has been contracted by the BROS Technical Committee, and thereby, as an authorized representative of the Settling Defendants, submits this document in compliance with the BROS Consent Decree.



Neil R. Rivers

Phase 2 RI/FS Project Manager

(Signed as per Paragraph 69 of the BROS Consent Decree)

c: Distribution List

Acronym And Unit Definitions

Acronyms	Description
ACL	Alternative Concentration Limit
ADQO	Alternate Data Quality Objective
AIC	Acceptable Intake - Chronic
AMSL	Above Mean Sea Level
AOC	Area of Concern
ARAR	Applicable or Relevant and Appropriate Requirements
ASP	Analytical Services Protocol
ASTM	American Society for Testing and Materials
ATSDR	Agency for Toxic Substances and Disease Registry
AUF	Area Use Factor
AWTS	Aqueous Wastewater Treatment System
BGS	Below Ground Surface
BOD	Biological Oxygen Demand
BROS	Bridgeport Rental and Oil Services
BTEX	Benzene, Toluene, Ethylbenzene and Total Xylenes
BTU	British Thermal Unit
CDM	Camp, Dresser and McKee
CEA	Classification Exception Area
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Register
CLP	Contract Laboratory Program
CLTL	Chemical Leaman Tank Lines
COD	Chemical Oxygen Demand
COPC	Constituent of Potential Concern
COPEC	Constituent of Potential Ecological Concern
CPF	Cancer Potency Factor
CRAVE	Carcinogen Risk Assessment Verification Endeavor
CRDL	Contract Required Detection Limit
CRPP	Community Relations Participation Proposal
CRQL	Contract Required Quantitation Limit
CRS	Cultural Resources Survey
DNAPL	Dense Non-Aqueous Phase Liquid
DO	Dissolved Oxygen
DQO	Data Quality Objective
DRBC	Delaware River Basin Commission
DRO	Diesel Range Organics
DUR	Data Usability Report

Acronym And Unit Definitions

Acronyms	Description
DVS	Data Validation Services
EDI	Estimated Daily Intake
ER-L	NOAA Effects Range - Low
ERA	Ecological Risk Assessment
FDA	Food And Drug Administration
FEMA	Federal Emergency Management Agency
FID	Flame Ionization Detector
FIT	Field Investigation Team
FOP	Field Operations Plan
FS	Feasibility Study
GIS	Geographical Information System
GPS	Global Positioning System
GRO	Gasoline Range Organics
GWQC	Ground Water Quality Criteria
HASCP	Health and Safety/Contingency Plan
HEAST	Health Effects Assessment Summary Tables
HHRA	Human Health Risk Assessment
HI	Hazard Index
HQ	Hazard Quotient
ICLR	Incremental Lifetime Cancer Risk
IDL	Instrument Detection Limit
IRIS	Integrated Risk Information System
LC50	Lethal Concentration (for 50% of Population)
LD50	Lethal Dose (for 50% of Population)
LEL	Lowest Effect Level
LNAPL	Light Non-Aqueous Phase Liquid
MCL	Maximum Contaminant Limit
N.J.A.C.	New Jersey Administrative Code
NAAQS	National Ambient Air Quality Standards
NAPL	Non-Aqueous Phase Liquid
NCEA	National Center for Exposure Assessment
NCP	National Oil and Hazardous Substance Pollution Contingency Plan
NGVD	National Geodetic Vertical Datum
NJDEP	New Jersey Department of Environmental Protection
NJDOT	New Jersey Department of Transportation
NOAA	National Oceanic and Atmospheric Administration
NOAEL	No Observed Adverse Effect Level

Acronym And Unit Definitions

Acronyms	Description
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
O&M	Operation and Maintenance
OSHA	Occupational Safety and Health Administration
OSWER	Office of Solid Waste and Emergency Response
OU	Operable Unit
PAHs	Polynuclear Aromatic Hydrocarbons
PCBs	Polychlorinated Biphenyls
PCE	Tetrachloroethylene
PEL	Permissible Exposure Level
PID	Photoionization Detector
PM ₁₀	Particulate Matter Less Than 10 Micron in Aerodynamic Diameter
PPE	Personal Protective Equipment
PQL	Practical Limits of Quantitation
PRAO	Preliminary Remedial Action Objective
PRG	Preliminary Remedial Goal
PRM	Potomac-Raritan-Magothy
PRP	Potentially Responsible Party
PWSC	Pennsgrove Water Supply Company
QA/QC	Quality Assurance/Quality Control
QAPP	Quality Assurance Project Plan
RA	Risk Assessment
RAGS	Risk Assessment Guidance for Superfund
RAO	Remedial Action Objectives
RBC	Risk-Based Concentration
RCRA	Resource Conservation and Recovery Act
RFD	Reference Dose
RI	Remedial Investigation
RMEI	Reasonable Maximum Exposed Individual
ROD	Record of Decision
ROST	Rapid Optical Screening Tool
SAB	Science Advisory Board
SAP	Sampling And Analysis Plan
SARA	Superfund Amendments and Reauthorization Act of 1986
SCBA	Self Contained Breathing Apparatus
SCC	Soil Cleanup Criteria
SHSO	Site Health and Safety Officer

Acronym And Unit Definitions

Acronyms	Description
SMDP	Scientific/Management Decision Point
SOP	Standard Operating Procedure
SOW	Scope of Work
SPHEM	Superfund Public Health Evaluation Manual
SPLP	Synthetic Precipitation Leaching Procedure
SQB	Stream Quality Benchmarks
SQL	Sample Quantitation Limit
SQO	Stream Quality Objectives
SSL	Soil Screening Level
SVOC	Semivolatile Organic Compound
TBC	To-Be-Considered
TCE	Trichloroethylene
TCL	Target Compound List
TCLP	Toxic Characteristic Leaching Procedure
TDI	Total Daily Intake
TDS	Total Dissolved Solids
TI	Technical Impracticability
TIC	Tentatively Identified Compound
TKN	Total Kjeldahl Nitrogen
TOC	Total Organic Carbon
TOX	Total Organic Halides
TPH	Total Petroleum Hydrocarbon
TSP	Total Suspended Particulate
TSS	Total Suspended Solids
UCL	Upper Confidence Limit
USACOE	United States Army Corps of Engineers
USDC	United States District Court
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
UST	Underground Storage Tank
VOC	Volatile Organic Compound
WET	Wetland Evaluation Technique

Acronym And Unit Definitions

Units	Description
$\mu\text{g}/\ell$	Micrograms per Liter
$\mu\text{g}/\text{m}^3$	Micrograms per Cubic Meter
μg	Micrograms
$\mu\text{g}/\text{kg}$	Micrograms per Kilogram
$\mu\text{g}/\text{kg}/\text{day}$	Micrograms per Kilogram per Day
$\mu\ell$	Microliters
μ	Microns
cm^2	Square Centimeters
$^{\circ}\text{C}$	Degrees Centigrade
$^{\circ}\text{F}$	Degrees Fahrenheit
kg	Kilograms
K_p	Dermal Permeability Coefficient
ℓ/cm^3	Liters per Cubic Centimeter
ℓ/m^3	Liters per Cubic Meter
ℓ/day	Liters per Day
ℓ	Liters
m^3/day	Cubic Meters per Day
m^3/hour	Cubic Meters per Hour
mg/ℓ	Milligrams per Liter
mg	Milligrams
mg/m^3	Milligrams per Cubic Meter
$\text{mg}/\text{kg}-\text{day}$	Milligrams per Kilogram per Day (Daily Exposure)
mg/cm^2	Milligrams per Square Centimeter
mg/day	Milligrams per Day
mg/kg	Milligrams per Kilogram
$\text{mg}/\text{kg}/\text{day}$	Milligrams per Kilogram per Day (Average Daily Exposure)
$\text{m}\ell$	Milliliters
mm Hg	Millimeters of Mercury
ppb	Parts per Billion
ppm	Parts per Million

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1. Analytical Laboratory Quality Assurance Plans

1.0 INTRODUCTION

The Quality Assurance Project Plan (QAPP) outlines the measures that will be taken to ensure that the data generated for the Phase 2 RI/FS at the Bridgeport Rental and Oil Services (BROS) NPL site are of quality sufficient to meet the data quality objectives of precision, accuracy and completeness, and usability for the purposes of evaluating remedial alternatives and assessing risk.

The QAPP presents the organization, objectives, functional activities and specific quality assurance (QA) and quality control (QC) activities associated with the sampling and analysis plan (SAP) that will be prepared as part of the Remedial Investigation (RI). The QAPP also describes the specific protocols which will be followed for sample handling and storage, chain of custody, and laboratory and field analysis activities. The specific protocols for sampling activities are provided in the SAP.

All QA/QC procedures have been developed and implemented in accordance with applicable professional technical standards, United States Environmental Protection Agency (USEPA) requirements, government regulations and guidelines, and specific project goals and requirements. The QAPP was prepared in accordance with the requirements of Appendix E of the Consent Decree for the BROS Site (USDC, 1996), with respect to content and format. Additionally, the following USEPA guidance documents were used, where applicable, to provide consistency with current USEPA QAPP requirements:

- *EPA Requirements for Quality Assurance Project Plans for Environmental Data Operations* (EPA QA/R-5) (USEPA, 1997),
- USEPA Region II *CERCLA Quality Assurance Manual*, and
- *Guidance for the Data Quality Objectives Process* (EPA QA/G-4) (USEPA, 1994).

The primary objective of the QAPP is to provide a project specific "blueprint" for obtaining the type and quality of environmental data needed to accurately reflect actual conditions at the BROS site. Deviations from expected conditions will be noted, and appropriate corrective measures will be taken to maintain quality in the sample collection and analysis program.

1.1 Contents

As required by the Consent Decree (USDC, 1996), the elements presented in this QAPP include Project Management (Sections 2.0 through 4.0), Measurement/Data Acquisition (Sections 5.0 through 10.0), Assessment/Oversight (Sections 11.0 through 13.0) and Data Validation/Usability (Sections 14.0 and 15.0). The format of the QAPP is specified in the Consent Decree. A cross-walk correlating the elements of this QAPP and the elements of *EPA Requirements for Quality Assurance Project Plans for Environmental Data Operations* is provided (Appendix A). Any future changes to USEPA guidance will only potentially apply to data not yet collected and will not be applied to samples already collected at the time the revision becomes effective. The individual laboratory QAPPs are provided in Attachment 1.

1.2 Project Description

The Phase 2 RI/FS and subsequent remediation activities are being completed pursuant to the BROS Consent Decree, which includes the funding provision for the work through all phases of the project. Soil, sediment, surface water, non aqueous phase liquid (NAPL), and ground water samples will be collected as part of the RI. Aquifer testing in the form of slug tests, step-drawdown pumping tests, and long-term constant-rate pumping tests will be performed to evaluate aquifer characteristics. Additional activities expected include monitoring well repair and installation, surveying, ecological evaluations, analytical method development activities and geophysical investigations. The scope of work for each data gathering effort will be described in more detail in the Sampling and Analysis Plan that will be prepared for this project. The project schedule for each of the data gathering efforts will also be described in the SAP. A more detailed description of project activities is provided in Appendix B.

In order to consistently meet the project data quality objectives (DQOs), laboratory analytical services will be provided by two off-site laboratories and one on-site laboratory. The on-site

laboratory will be used for the testing of soils, sediments, ground water and investigation-derived wastes (e.g. development water, drill cuttings). The on-site testing of soils, sediments and ground water will be used to optimize the sampling locations for more detailed off-site laboratory analysis in addition to increasing the number of data points that will be used in establishing the nature, gradients and extent of contaminants of potential concern. The on-site testing of soil samples will also be used to select samples for off-site laboratory analysis and to provide the off-site laboratory with advance notice of probable concentrations and potential matrix interference concerns. The analysis of investigation-derived wastes will be used to segregate and consolidate waste streams to ensure proper disposal. Additional detail about the specific analytical methods and QA/QC procedures for the on-site laboratory are provided throughout this QAPP and in the laboratory-specific Quality Assurance Plan provided as an attachment to this QAPP. Two off-site laboratories will be used so that analytical services will coincide with each laboratory's technical strength and experience and to ensure adequate capacity for laboratory services throughout the project. The division of work between the laboratories is further described in Section 7.4.

The laboratory service firms that have participated in the development of this QAPP, and who will perform the chemical analyses of samples from the BROS site, evaluated potential matrix interference concerns based on the review of past site data. The laboratories were tasked with identifying potential laboratory methods which can reliably achieve detection limits consistent with the numeric DQOs, given the matrix interference problems in samples from certain portions of the site. Based upon this evaluation, the laboratories proposed that USEPA SW-846 methodologies be used for volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), polychlorinated biphenyls (PCBs) and target analyte list (TAL) metals, rather than CLP methods; and that method development activities be conducted prior to the receipt of site characterization samples.

The use of USEPA SW-846 methods for problem matrices commonly encountered at the BROS site will provide the laboratory with greater flexibility in methodology and cleanup procedures which, in the experience of the laboratories, will enable the laboratories to achieve lower detection limits and a higher percentage usable data that are more consistent with the project

DQOs. As provided in more detail in Section 7.1 of this QAPP, the laboratories will follow USEPA SW-846 or other appropriate approved methods while maintaining consistency with CLP deliverables, to the extent practical.

To further develop the applicability of the USEPA SW-846 methods for the BROS site, the laboratories will use media from the BROS site to evaluate potential method modifications and cleanup methods for VOC, SVOC and PCB analyses as a means of addressing matrix interferences before site characterization samples are received (Section 14.3). The completion of method development activities ahead of the site characterization will provide the laboratories with the ability to perform various trial modifications without exceeding the holding times for characterization samples. Further, the early development and approval of revised methods will reduce the probability of having to repeat sampling and field activities due to critical RI data being qualified or rejected. The laboratories will evaluate the effectiveness of using sample extract cleanup methods and SIM analysis and recommend method changes for inclusion in the QAPP. A Technical Memorandum detailing proposed sample extract cleanup methods and method modifications will then be prepared and submitted to the USEPA for review and approval.

1.3 Specific Phase 2 RI/FS Objectives

The specific Phase 2 RI/FS objectives are a function of the data needs which were identified and refined during the Phase 2 RI/FS Work Plan (Work Plan) scoping process. The new data and additional information will be used to complete the compilation of the relevant information needed for the selection of remedial options.

Overall objectives for data generated as part of this investigation are described in the SAP and summarized in Appendix B. The SAP objectives which require collection of field data include the following:

- Objective 1 - Establish a Water Budget for the Site
- Objective 2 - Establish the Spatial Distribution, Volume and Mass of Contaminants Associated with Residual Sources Areas

- Objective 3 - Establish the Vertical Distribution and Characteristics of the Fill, Ash and Lime, and Cover Material Layers in the Former Lagoon
- Objective 4 - Determine the Distribution and Gradients of Constituents of Potential Concern (COPC) along Potential Exposure Pathways under Current Site Conditions
- Objective 5 - Establish the Degree of Hydraulic Connection Between the Aquifers and Surface Water
- Objective 6 - Establish the Hydrogeologic and Chemical Relationship Between the Chemical Leaman Tank Lines (CLTL) Site and BROS site
- Objective 7 - Assess the Environmental Fate and Transport of COPCs under Current Site Conditions and Model Future Fate and Transport of COPCs
- Objective 8 - Determine Representative Exposure Point Concentrations and Characterize Potential Receptors
- Objective 9 - Establish a Range of Remedial Alternatives that are Protective of Human Health and the Environment and Conduct Screening of Alternatives
- Objective 10 - Conduct Relevant Treatability Studies
- Objective 11 - Complete the Cultural Resources Survey Requirements

A more detailed description of the project objectives is provided in Appendix B.

2.0 PROJECT ORGANIZATION AND RESPONSIBILITY

The overall management structure and a general summary of the responsibilities of project team members is presented below (Figure 1). Resumes for the key project personnel are provided in Appendix C.

BROS Technical Committee

The BROS Technical Committee is responsible for the implementation of the Phase 2 RI/FS. The BROS Technical Committee is responsible for making strategic decisions and monitoring the overall project progress.

Project Coordinator

The Project Coordinator serves the BROS Technical Committee in an overall project direction and administrative capacity. Dr. Peter Brussock of Environmental Liability Management (ELM) is the Project Coordinator. Dr. Brussock has over 12 years experience in the environment regulatory field, including direct CERCLA management experience, and possesses a Doctorate Degree in Aquatic Ecology and Water Resources. The Project Coordinator serves as a liaison between the BROS Technical Committee, the USEPA and the RI/FS Contractors, consistent with the BROS Consent Decree. The Project Coordinator manages the monthly progress reporting and cost tracking requirements stipulated in the Consent Decree as well as the BROS Technical Committee review and approval of project deliverables through the distribution of draft reports, interpretation and reduction of comments, and the presentation of comments to the RI/FS Contractor. In addition, the Project Coordinator provides strategic and technical comments based upon their review of project deliverables.

Project Manager

The Project Manager works for the RI/FS Contractor and is responsible for defining project objectives. Mr. Neil Rivers of Roux Associates, Inc. will serve as the Project Manager. Mr. Rivers has 18 years of experience in related activities, including direct CERCLA project management experience, and possesses a Bachelors Degree in Biology and 28 credits towards a Masters Degree in Environmental Engineering. The Project Manager bears the responsibility for

the successful completion of the work assignment within budget and schedule. This individual provides overall management for the execution of the Work Plan and directs the activities of the RI Manager, the Field Team Leaders and the technical staff. The Project Manager performs technical review of field activities, data review and interpretation and preparation of the Work Plan. Activities of the Project Manager are supported by the Project Principal, the Project Quality Assurance Coordinator, and the RI Manager.

RI Manager

The RI Manager provides overall management for the execution of the RI and directs the activities of the Field Team Leaders, Laboratory Manager, and Drilling Services Manager. Mr. William Gilchrist of Roux Associates, Inc. will serve as the RI Manager. Mr. Gilchrist has 12 years of experience in conducting environmental investigations and possesses a Masters Degree in geology. Responsibilities of the RI Manager include coordination of all field activities, data review and interpretation, and report preparation.

Field Team Leader

The Field Team Leader bears the responsibility for the successful execution of the field program. Mr. John Lucey of Roux Associates, Inc. will serve as the Field Team Leader. Mr. Lucey has 10 years experience directing environmental site investigations and possesses a Masters Degree in geology. Additionally the Field Team Leader will be health and safety trained in accordance with the Occupational Safety and Health Administration's (OSHA) 1910.120. The Field Team Leader directs the activities of technical staff in the field and assists in the interpretation of physical and chemical data, and report preparation. Responsibilities include the management of technical staff, and oversight of subcontractors such as the driller and laboratory. The Field Team Leader reports to the RI Manager.

Site Health and Safety Officer

The Site Health and Safety Officer (SHSO) is responsible for health and safety activities throughout the Phase 2 RI/FS. Ms. Brigid Tigani of Roux Associates, Inc. will serve as the SHSO. Ms. Tigani has 3 years of experience implementing health and safety plans in relation to environmental site investigations and possesses a Bachelors Degree in geology. The SHSO will

also be trained in accordance with OSHA 1910.120. The SHSO is responsible for implementation of the Health and Safety Plan. The SHSO works with the Field Team Leader, but reports directly to the Project Manager.

Laboratory Project Managers

Three laboratories, a primary off-site analysis laboratory, a backup/specialty analysis laboratory and a mobile laboratory will be used during the course of the project. Three laboratories were selected to provide rapid on-site screening and to ensure capacity and technical expertise for the complex matrices known at the BROS site.

The Laboratory Project Managers are:

- Ms. Missy McDermott - Lancaster Laboratories, Inc. (LLI); and
- Mr. Lonnie Fallin - OnSite Environmental Laboratories, Inc. (OnSite).

The Laboratory Project Managers are responsible for sample container preparation, sample custody in the laboratory, and completion of the required analysis through oversight of the laboratory staff. The laboratory project managers have a minimum of 10 years experience in an analytical laboratory setting and possess a Bachelors Degree in chemistry or a related field. The Laboratory Project Managers will ensure that quality assurance procedures are followed and that an acceptable laboratory report is prepared and submitted. The Laboratory Project Managers report to the RI Manager.

Drilling Services Manager

The Drilling Services Manager is responsible for providing the appropriate labor, equipment and materials to conduct soil borings and install monitoring wells in accordance with the SAP. Mr. Gerald Freck will serve as the Drilling Services Manager. Mr. Freck has 17 years of experience directing drilling related activities for environmental site investigations. The Drilling Services Manager also ensures that the appropriate drilling permits are secured and that boring/well logs are completed for the work done. The Drilling Services Manager reports to the RI Manager.

Project Quality Assurance Coordinator

The Project Quality Assurance Coordinator (PQAC) is responsible for conducting reviews, inspections, and audits to assure that the data collection is conducted in accordance with the SAP. Ms. Joanne Yeary of Roux Associates, Inc. will serve as the PQAC. Ms. Yeary has 12 years of experience evaluating data quality and possesses a Bachelors degree in geology. The PQAC's responsibilities range from ensuring effective field equipment decontamination procedures and proper sample collection, to the review of all laboratory analytical data (including tentatively identified compounds, if analyzed) for completeness and usefulness. When necessary, analytical chemistry technical support will be provided to the PQAC by Dr. Paul Rosenstock of Roux Associates, Inc. and the data validator. The Project Quality Assurance Coordinator reports to the Project Manager.

3.0 OBJECTIVES AND SCHEDULE

3.1 Overall Project Objectives

The specific Phase 2 RI/FS objectives are a function of the data needs which were identified and refined during the Phase 2 RI/FS Work Plan (Work Plan) scoping process. The new data and additional information will be used to complete the compilation of the relevant information needed for the selection of remedial options. The Phase 2 RI/FS objectives which have been integrated into the scope of work presented in the Work Plan are summarized below:

- Objective 1 - Establish a Water Budget for the Site
- Objective 2 - Establish the Spatial Distribution, Volume and Mass of Contaminants Associated with Residual Sources Areas
- Objective 3 - Establish the Vertical Distribution and Characteristics of the Fill, Ash and Lime, and Cover Material Layers in the Former Lagoon
- Objective 4 - Determine the Distribution and Gradients of COPCs along Potential Exposure Pathways under Current Site Conditions
- Objective 5 - Establish the Degree of Hydraulic Connections Between the Aquifers and Surface Water
- Objective 6 - Establish the Hydrogeologic and Chemical Relationship Between the CLTL Site and BROS site
- Objective 7 - Assess the Environmental Fate and Transport of Constituents of Potential Concern (COPC) under Current Site Conditions and Model Future Fate and Transport of COPCs
- Objective 8 - Determine Representative Exposure Point Concentrations and Characterize Potential Receptors

- Objective 9 - Establish a Range of Remedial Alternatives that are Protective of Human Health and the Environment and Conduct Screening of Alternatives
- Objective 10 - Conduct Relevant Treatability Studies
- Objective 11 - Complete the Cultural Resources Survey Requirements

The field investigation will include the following activities:

- surface soil and subsurface soil boring sampling;
- NAPL investigations and sampling;
- monitoring well installation;
- ground water sampling; and
- surface water and sediment sampling.

Samples will be analyzed for Target Compound List (TCL) VOCs, TCL SVOCs, polychlorinated biphenyls (PCBs) and/or TAL metals as well as geochemical and geotechnical parameters. The projected sample matrix, analytical parameters and frequencies of field sample collection are provided in Tables 2 and 3. In addition, sampling for toxicity testing and tissue analysis will be included in a subsequent phase of investigation.

Waste characterization will be performed on development/evacuation water, LNAPL, drill cuttings, soil and sediment samples. These samples will be analyzed for Resource Conservation and Recovery Act (RCRA) characteristics (e. g., ignitability, corrosivity, reactivity and toxicity) and similar parameters associated with waste acceptance at disposal facilities.

3.2 Data Quality Objectives

Prior to scoping the Phase 2 RI/FS and selecting analytical methods, the DQOs for the project were developed using the seven step DQO Process detailed in *Guidance for the Data Quality Objectives Process-EPA QA/G4* (USEPA, 1994). The expected outputs for each step of this process are described in below.

Step 1 - Planning Team/Statement of the Problem

Planning Team

The BROS Technical Committee is responsible for project planning and development of DQOs. The BROS Technical Committee is composed of senior managers employed by certain Settling Defendants and have selected Environmental Liability Management, Inc. as the Project Coordinator and Roux Associates, Inc. as the Phase 2 RI/FS Contractor. The Project Manager for the Phase 2 RI/FS Contractor and the Project Coordinator are the primary decision makers with respect to planning and the establishment of DQOs, subject to review and approval by the USEPA.

Statement of the Problem

At various times, operators of the facility used the site for waste management purposes, including waste oil reprocessing, waste disposal, and waste storage. Activities conducted at the site resulted in the release of chemicals to the environment which resulted in the contamination of various media including soil, ground water, surface water, and sediment. The USEPA placed the site on the National Priorities List on September 8, 1983 and commenced a Remedial Investigation and Feasibility Study (RI/FS). The RI/FS identified several sources of contamination and various contaminated areas. The predominant constituents of potential concern identified in the RI/FS are petroleum hydrocarbons, VOCs (including aromatic and chlorinated volatile compounds), lead and PCBs. On December 31, 1984, USEPA issued a Record of Decision (ROD) which called for: (1) installation of a water supply line to replace private water supplies near the site; (2) dismantling of the tank farm at the site; (3) excavation and on-site incineration of lagoon sediment; and (4) performance of a Phase 2 RI/FS to address ground water at quality for the site and surrounding areas.

In accordance with the Consent Decree, several remedial actions were performed at the BROS property to address the primary sources. These included removal of the tanks and drums and the demolition and removal of site buildings and miscellaneous site debris. Approximately 400,000 gallons of oils and sludges contained within the tanks and process vessels were disposed off-site. During the lagoon cleanup over 172,000 tons of material including lagoon sediments, sludges and oil were removed and incinerated on-site.

In 1990 and 1991, the USEPA also conducted preliminary remedial investigation activities to assess the quality of soils, ground water, and wetlands at the site. Data from these investigation activities are summarized in a report compiled by the USEPA's contractor (CH₂M Hill, 1996). Between November 1996 and February 1997 the USACOE, under the oversight of the USEPA, performed a Phase 3 soil investigation in the former Process and Tank Area (USEPA, 1998). Soil borings were completed to evaluate the potential presence of buried drums or debris based on a geophysical survey performed by USEPA contractors. Additional information regarding the operational history and past environmental investigations is provided in Appendix B.

The primary contaminant sources (spillage, process tanks, storage tanks, and the lagoon) have been largely removed or eliminated as part of the remedial activities conducted to date at the site. Secondary sources are still present at the site and include contaminated soils (surface and subsurface), lagoon residuals, NAPL, and contaminated wetland sediments. Based on the conceptual model developed for the site (See Figures 4, 17 and 29 of the Work Plan), these secondary sources may also be contaminating other media, both on-site and off-site, through a variety of contaminant transport mechanisms. Mechanisms for the transport of site-related contaminants to other media include: surface water runoff, infiltration, percolation, dissolution, ground water transport, biologic uptake, volatilization and wind transport of dust.

During the scoping process, exposure scenarios have been evaluated for specific applicability to the site, and additional information is needed to verify and quantify exposure scenarios as needed to estimate risk to human and ecological receptors (See Figure 30 of the Work Plan). For example the probability of human exposure to sediments is limited by the relative inaccessibility of the wetlands, so a risk assessment data need is to estimate the frequency of exposure to wetlands sediments. Other human health-related exposure scenarios that will be evaluated include current and future ground water use, exposure to on-property and off-property soils, ingestion of fish from Swindell and Gaventa Ponds, and exposure to surface water in the ponds. Ecological exposure scenarios to be evaluated are predominantly related to the uptake of contaminants present in surface water and sediment. The Phase 2 RI/FS includes data collection activities to support the determination of which exposure scenarios occur at the site and to

provide information to quantify the frequency of exposure in support of the risk assessment and remedial alternatives evaluation.

Step 2 - Decision Statement

Based upon the review of site data generated to date, additional data collection activities are necessary. The extent of impacted media has not been adequately defined and a more detailed understanding of the distribution of COPCs in the various media present at the site is required to support the baseline risk assessment and determine what portions of the site warrant detailed evaluation of remedial alternatives. Site conditions and chemical characterization are needed to complete the evaluation of COPC fate and transport in the environment, to assess the remedial alternatives and to support the remedial design.

To more fully understand the distribution and fate of COPCs at the site, additional investigations of the various impacted media; including soil, ground water, surface water and sediment; must be conducted to supplement existing data and adequately evaluate the nature, extent and mobility of COPCs in the various media. The planned investigations to generate the information required to adequately evaluate the nature, extent and mobility of COPCs present in the various media at the BROS site are detailed in the Phase 2 RI/FS Work Plan and Sampling and Analysis Plan.

Step 3 - Inputs to the Decision

To resolve the decision statement, the Phase 2 RI/FS must:

- obtain measurements of the concentrations of COPCs in soil, ground water, sediment and surface water;
- characterize the physical and chemical properties of NAPL;
- characterize the physical and geochemical properties of the various media;
- establish a water budget for the site in support of the evaluation of surface water/ground water interactions and COPC fate and transport;

- identify potential pathways for the migration of COPCs; and
- obtain data that can be reliably used to calculate the risks posed by COPCs detected throughout the site.

The activities proposed to obtain the above described information are provided in the Phase 2 RI/FS Work Plan and the Sampling and Analysis Plan.

To properly evaluate site conditions, initial preliminary remedial goals (PRGs) were developed for each of the impacted matrices based on health-based criteria. The PRGs are action levels for COPCs in the various media and are described below.

The initial PRGs for soils are the NJDEP Soil Cleanup Criteria (SCC) as published on July 11, 1996. Initial PRGs for the BROS property will be the more stringent of the Restricted Use or Impact to Ground Water SCC. The initial PRGs for the off-property areas will be the more stringent of the Unrestricted Use or Impact to Ground Water SCC. If a compound is detected that does not have an established NJDEP SCC, the generic Soil Screening Levels (SSLs) provided in Table 1A-1 of the USEPA publication *Soil Screening Guidance: Users Guide* (USEPA, 1996a) will be used as the initial PRG. A summary of initial PRGs for COPCs in soil based on historical site data is provided (Table 1A).

The initial PRGs for ground water are the more stringent of the New Jersey Ground Water Quality Standards for Class II-A Aquifers (N.J.A.C. 7:9-6.9) or the Maximum Contaminant Levels (MCLs) at 40 CFR 141. A summary of initial PRGs for COPCs in ground water based on historical site data is provided (Table 1B).

The initial PRGs for surface water will be the lower of the New Jersey Surface Water Quality Standards (N.J.A.C. 7:9B-1.14) or the Ambient Water Quality Standards at 40 CFR 131.36. The Delaware River and Basin Commission (DRBC) Stream Quality Objectives (SQOs) published in the *Delaware River Basin Water Code* (DRBC, 1996) may be applicable to surface water

discharges generated during remedial activities. A summary of initial PRGs for COPCs in surface water based on historical site data is provided (Table 1C).

The initial PRGs for metals, semivolatile organic compounds, and polychlorinated biphenyls in sediments are the more stringent of the lower effects level (LEL) from *the Guidelines for the Protection and Management of Aquatic Sediments Quality in Ontario*, as published by the Ontario Ministry of Environment and Energy (Persaud *et. al.*, 1993) or the Apparent Effects Thresholds (AETs) from the *Creation and Analysis of Freshwater Sediment Quality Values in Washington State*. The initial PRGs for volatile organic compounds in sediments are the Sediment Quality Benchmarks (SQB) developed by Oak Ridge National Laboratory in the document *Toxicological Benchmarks for Screening Contaminants of Potential concern for Effects on Sediment Associated Biota* (Suter *et. al.*, 1994). The Ontario guidelines were applied as they are based upon potential effects in freshwater systems - although much of the data used to develop the Ontario guidelines comes from lake ecosystems (i.e. the Great Lakes region) and may not be an appropriate match for the stream and marsh ecosystems in the vicinity of the BROS site. If an LEL does not exist for a compound, then the effects range low (ER-L) from *Incidence of Adverse Biological Effects Within Ranges of Chemical Concentrations in Marine and Estuarine Sediments* (Long *et. al.*, 1995) was used. The use of freshwater or estuarine guidelines in establishing PRGs for wetlands sediments will be reevaluated based upon the further assessment of site-related hydrology as part of the Phase 2 RI. A summary of initial PRGs for COPCs in sediment based on historical site data is provided (Table 1D).

To ensure that the analytical methods can adequately characterize the media of concern, numeric DQOs have been established for this project, as described in Section 3.3.1. These numeric DQOs were set at 50 percent of the PRG to allow for protection against decision error based on measurement error incurred during the sampling and analysis process.

Step 4 - Study Boundaries and Identify Practical Constraints

Spatial Boundaries

The spatial boundaries of the site are defined by the extent of contamination attributable to the BROS Site, pursuant to the BROS Consent Decree (USDC, 1996). The Site includes the BROS

property, portions of the Little Timber Creek Swamp where contamination is known or suspected, Gaventa Pond and surrounding areas, Swindell Pond and surrounding areas, other neighboring properties to the north and west, and those areas where site-related ground water contaminants exist.

Temporal Boundaries

It will be assumed that the planned Phase 2 RI/FS will establish the current concentrations of COPCs in the various media present at the site. Ground water and surface water modeling (Task IIIB, Activity 4 of the Phase 2 RI/FS Work Plan), based on data collected during the RI/FS field activities, will be used to estimate the future concentrations of COPCs across the site. Data collection will commence within two months after USEPA approval of the Phase 2 RI/FS Work Plan and Field Operations Plan and will continue for a period of at least two years. The project schedule is provided on Plate 1.

Practical Constraints

Practical constraints on data collection include the following:

- limited access due to physical constraints (see Section 6.3 of the Work Plan and Section 7.5.1 of the Sampling and Analysis Plan);
- limited access imposed by property owners constraints (see Section 6.3 of the Work Plan and Section 7.5.1 of the Sampling and Analysis Plan); and
- limitations in the detection limits for chemical analysis due to matrix interference.
- matrix interference considerations are discussed below and elsewhere in the QAPP.

Matrix Interference

The laboratory service firms that have participated in the development of this Work Plan, and who will perform the chemical analyses of samples from the BROS site, evaluated potential matrix interference concerns based on the review of past site data. The use of CLP and Test

Methods for Evaluating Solid Waste (USEPA SW-846) methodologies for the analysis of soil, ground water, sediment and surface water samples were evaluated for their ability to characterize concentrations of COPCs in the various media. The laboratories were tasked with identifying potential laboratory methods which can reliably achieve detection limits consistent with the DQOs, given the likely matrix interference concerns. As many of the PRGs values are at or below the CLP Contract Required Detection Limits (CRDLs) and matrix interference problems have been documented during previous phases of investigation, USEPA SW-846 methodologies were recommended. The use of USEPA SW-846 methods will provide the laboratory with greater flexibility in methodology and cleanup procedures which, in the experience of the laboratories, will enable the laboratories to achieve lower detection limits and a higher percentage usable data that are more consistent with the project DQOs. As provided in more detail in Section 7.1 of this QAPP, the laboratories will follow SW-846 or other appropriate approved methods while maintaining consistency with CLP protocols, to the extent practical.

Step 5 - Decision Rule

The Phase 2 RI/FS will establish the concentrations and gradients of COPCs in the various media at the site, consistent with relevant risk assessment and remedial alternative evaluation guidance. The COPC concentrations will be compared to the PRGs detailed in Tables 1A through 1D to evaluate if further investigative activity is required. If a COPC's concentration exceeds the PRG for its media, the need for further risk assessment will be evaluated based on the procedures detailed in Section 14.3 of this QAPP. If the risk assessment determines that an unacceptable risk to ecological receptors or human health is present, remedial activities will be evaluated to reduce the risk.

Step 6 - Limits on Decision Errors

To establish performance goals for the data collection process, tolerable decision error rates were evaluated for the project. During this process, two types of decision error for the BROS site were identified:

- deciding an unacceptable risk to the environment or human health is present even when no unacceptable risk is truly present; and

- deciding no unacceptable risk to the environment or human health is present when there truly is an unacceptable risk present.

The consequences of deciding whether an unacceptable risk is present when it truly is not will result in spending significant financial resources to evaluate remedial alternatives, select a remedial alternative and implement the alternative. Additionally, due to the nature of the areas surrounding the BROS site, implementing a remedial activity could result in unnecessary disturbance to wetland areas and surface water bodies. The consequences of deciding that no unacceptable risk is present when an unacceptable risk truly is present could possibly endanger human health and the environment and result in additional environmental cleanup costs. The consequences of the later decision error are potentially more severe since an unacceptable risk to human health and the environment outweighs spending some additional financial resources beyond what is necessary to reduce risks to acceptable levels. As such, the baseline condition or null hypothesis for the site is that a risk is present.

Limits to acceptable decision error rates were developed based on guidance provided in EPA QA/G-4 (USEPA, 1994), which specifies that the limits to acceptable decision errors should be developed on a case by case basis after consideration of the risk of making a decision error and the probability of measurement and sampling design errors. Given the potentially high cost of controlling sampling design and measurement error for environmental data, USEPA 1994 specifies that decision error rates greater than 1% are appropriate where the planning team has determined that the costs and resource expenditures associated with this more stringent decision error rate did not provide additional benefit to human health or ecological risk. A 15% decision error rate has been established for the Phase 2 RI/FS. This decision error rate is consistent with EPA QA/G-4 (USEPA, 1994) in that significant costs and technical resources are being applied to reduce measurement errors and sampling design errors, controlling the probability of decision errors. Specifically, the probability of measurement errors and sampling errors is reduced because:

- the Phase 2 RI/FS will be building upon a sizable quantity of existing data;

- the conceptual site model is relatively well established and the majority of human receptors are located far from the primary or secondary sources;
- a comprehensive, extensive investigation (for example, continuous split-spoon sampling at soil borings and the installation of 45 additional monitoring wells) has been developed in consultation with USEPA;
- the investigation will employ field screening using USEPA SW-846 methods at an on-site laboratory to rapidly screen samples and optimize sample locations for laboratory analysis;
- the standard USEPA SW-846 methods will be refined to address site-specific matrix interference issues to achieve better detection limits that are consistent with the project DQOs and the PRGs;
- matrix-specific numeric DQOs based on human health and ecological risk criteria have been developed and considered in the selection of analytical methods to minimize the potential impacts of measurement error on decision making;
- SOPs for sample collection, sampling handling and data reduction that rely on current guidance and technical articles will be used during the course of the project; and
- many of the samples will be biased to areas of expected contamination and other samples will be collected along established flow paths from primary and secondary sources.

Areas where decision errors with respect to the null hypothesis are of greatest concern will be at the potential exposure points where COPC concentrations are not predicted to significantly exceed ARARs (i.e. near the action level). As detailed in EPA QA/G-4 (USEPA, 1994), the acceptable decision error near the action level is typically higher than at other toxicological thresholds. Tighter limits for decision error would have an adverse impact to the project costs and resource expenditure as described below, without significant benefit in terms of human health or ecological protectiveness.

- More rigorous limits would result in increased laboratory costs due to sample extract cleanup methods used and other method modifications required to meet the numeric DQOs. Even using the sample extract cleanup methods planned for the RI (Section 14.3) and other method modifications (Section 14.3), more stringent numeric DQOs based upon a lower decision error may not be achievable short of the development of new methods.
- Increased RI costs, including the use of Contractor and agency resources to complete and approve the work, would be incurred due to increased sample density beyond that needed for risk assessment and the FS.
- Numeric DQOs, based on 50 percent of the relevant PRG, have been established for this project. The selection of 50% of the PRG is intended to allow for anticipated difficulties in meeting the method detection limit due to matrix interference, while providing a low enough numeric DQO to protect against changes in regulatory standards and potential measurement errors.

Step 7 - Optimize the Design for Obtaining Data

The Phase 2 RI/FS Work Plan is designed to evaluate site conditions to the extent necessary to support baseline risk assessments with representative analytical data that are reliably precise and accurate, as well as select a remedy for the BROS Superfund site. Consistent with the Statement of Work in the Consent Decree, the Work Plan is designed based upon evaluations conducted during the scoping process, including a review of available data from prior investigations and remedial actions at the site. In addition, Roux Associates, Inc. relied on the National Contingency Plan (NCP, 1990), the New Jersey *Technical Requirements for Site Remediation* (N.J.A.C. 7:26E), and the USEPA *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (USEPA, 1988) to scope the design of the Phase 2 RI/FS Work Plan.

The Phase 2 RI study will collect the data necessary to adequately characterize the site for the purpose of developing and evaluating effective remedial alternatives, building upon the

previously conducted studies and remedial actions. In addition, the Phase 2 RI site characterization will provide the information necessary for the completion of a site-specific baseline risk assessment which will evaluate the current and potential threats to human health and the environment that may be posed by residual contaminants in ground water, surface water, air, soil, sediment or potentially bioaccumulating in the food chain. The risk assessment will be used to support the development, evaluation, and selection of appropriate response alternatives in the Phase 2 FS (USEPA, 1998b).

The primary objective of the Phase 2 FS will be to ensure that appropriate remedial alternatives are developed and evaluated so that relevant information concerning the remedial action options can be presented to a decision-maker and an appropriate remedy can be selected. Development of the alternatives will be fully integrated with the site characterization activities of the Phase 2 RI. Alternatives will be developed to protect human health and the environment by eliminating, reducing, and/or controlling risks arising from each pathway associated with the entire site as well as risks arising from specific areas of concern or hot spots.

3.3 Numeric Data Quality Objectives

Due to the nature of the media and contaminants at the BROS Superfund Site, the detection limits required to meet the PRGs will not be achievable for the matrices and parameters listed below.

- For sediment:

- | | | |
|---------------------------|-----------------------------|----------|
| – Acetone | – trans-1,3-dichloropropene | – silver |
| – carbon disulfide | – dibenzo [a,h] anthracene | |
| – cis-1,3-dichloropropene | – PCBs | |

- For surface water:

- | | | |
|-----------------------------|---------------------------|----------------------------|
| - Benzene | - tetrachloroethene | - dibenzo [a,h] anthracene |
| - Bromodichloromethane | - vinyl chloride | - 3,3'-dichlorobenzidine |
| - carbon tetrachloride | - benzo [a] anthracene | - 2,4-dinitrotoluene |
| - 1,2-dichloroethane | - benzo [b] fluoranthene | - hexachlorobenzene |
| - cis-1,3-dichloropropene | - benzo [k] fluoranthene | - indeno[1,23-cd]pyrene |
| - trans-1,3-dichloropropene | - benzo [a] pyrene | - n-nitrosodipropylamine |
| - methylene chloride | - bis(2-chloroethyl)ether | - antimony |
| - 1,1,2,2-tetrachloroethane | - bis(2- | - arsenic |
| - beryllium | ethylhexyl)phthalate | - nickel |
| - copper | - lead | - thallium |
| | - mercury | |

- For ground water:

- | | | |
|------------------------|-----------------------------|---------------------------|
| - benzene | - 1,1,2,2-tetrachloroethane | - indeno [1,23-cd] pyrene |
| - Bromodichloromethane | - tetrachloroethene | - antimony |
| - 1,2-dichloroethane | - vinyl chloride | - arsenic |
| - 1,2-dichloropropane | - 1,1,2-trichloroethane | - lead |
| - methylene chloride | - hexachlorobutadiene | - thallium |

This condition has been recognized and the Consent Decree allows the PRPs to develop alternate data quality objectives (ADQOs), based on the site-specific conditions and subject to approval by the USEPA. The rationale for development of the site-specific ADQOs is provided below.

The ADQOs selected for the site must provide the data to be used for the following purposes:

- site characterization;
- risk assessment;
- evaluating potential remedial alternatives; and
- conceptual engineering design during the FS.

Within the context of the risk assessment and the FS, laboratory data will be used for estimating the volumes and distributions of COPCs through the use of interpolation and extrapolation along gradients. These results will then be used to calculate probable concentrations of exposure (with subsequent comparison to PRGs and other risk-based objectives) and to estimate restoration times for different alternatives.

ADQOs for the risk assessment have been established to ensure that representative data are collected for realistic exposure scenarios. The site complexities and matrix interferences associated with analysis of soil, sediment and lagoon residual samples warrant the use of lower ADQOs. Data are useable for risk assessment and remedial alternatives analysis purposes, provided the numeric DQO target of 50 percent of the PRG is met on the majority of samples. The concerns for matrix interference are more significant for the wetlands samples and ground water samples near the source areas of contamination, where the greatest potential exposures to ecological receptors are expected and where significant resources will be concentrated when preparing the ecological risk assessment. As the ecological risk assessment will integrate both quantitative (i.e. bottom up) and semi-quantitative (i.e. top down) ecosystem approaches, the site-specific numeric DQOs will support the development and interpretation of risk-based remedial action alternatives.

To ensure that data quality needs are met and the above objectives are achieved, the proposed numeric DQOs for laboratory analytical methods are 50 percent of the PRGs, with the exception of selected COPCs in ground water that have standards based on the practical quantitation limits of (PQLs) and for the compounds listed above where the PRGs are below the PQL or MDL.

The MDLs for the following analytes in ground water are below the PRGs but above their DQOs:

- benzene;
- trichloroethene;
- tetrachloroethene;
- 1,1,2-trichloroethane;

- vinyl chloride.

The DQOs for these compounds will be the MDL, as specified in the USEPA's May 4, 1999 letter.

Using the standard methods the MDLs will be above the surface water PRG for PCBs. By further concentrating the PCB sample extracts from surface water samples by a factor of ten, the MDLs for these compounds will be below the PRGs but above the DQOs. For PCBs, the MDLs using concentrated sample extracts will be the DQOs.

Using the standard VOC and SVOC methods the MDLs for benzene and benzo(a)pyrene will be above the surface water PRGs for these compounds. The use of selected ion monitoring (SIM) is the only method modification that could lower the MDLs below the PRGs. However, the laboratory cannot guarantee that the MDLs will be consistently below the PRGs. The taking into consideration the expense of method development, additional analytical costs, and the likelihood that the laboratory will not be able to achieve the PRGs, it is recommended that the standard VOC and SVOC methods be employed and the PRGs for benzene and benzo(a)pyrene be changed to the MDLs.

The selection of 50% of the PRG is intended to allow for anticipated difficulties in meeting the method detection limit due to matrix interference, while providing a low enough numeric DQO to protect against changes in regulatory standards and potential measurement errors. In the instances where the PRG is below the MDL or PQL, the PRG will be the MDL. The most stringent DQOs are for residential well sampling based upon risk assessment objectives and the importance of providing accurate data to the property owner. For these compounds, the DQOs will be 50% of the applicable PRG or drinking water levels. The ability to achieve the proposed DQOs for each of the matrices will be evaluated as part of the method development activities described in Section 14.3.

As detailed elsewhere in the QAPP, the laboratories will perform all relevant quality control steps and procedures associated, even if such QC measures are optional in the method. This will

ensure the SW-846 data packages will follow a similar format as the CLP package that can be validated according to Region 2 data validation criteria.

To achieve these numeric DQOs, the laboratories will follow USEPA SW-846 methods while maintaining consistency with CLP deliverables, to the extent practical. To ensure that the SW-846 data packages appear similar in format to CLP data packages and that data validation can be readily accomplished, all applicable quality control measures associated with the selected SW-846 method will be performed, even if the quality control measures are optional. The elements that will be included in the SW-846 data packages that will be provided are discussed in detail in Section 7.1 of this QAPP. For non-conventional analyses, other published sources such as American Society Testing and Materials (ASTM) methodologies will be used. USEPA SW-846 methods will be used in place of CLP methodologies for the following reasons:

- they have lower MDLs;
- allow for sample extract cleanup to minimize matrix interference effects;
- allow the use of method modifications to achieve lower detection limits;
- allow all targeted analytes to be spiked;
- in the case of PCBs, actual PCBs are used in the spike samples whereas CLP methodologies use pesticides; and.
- will result in data uncertainty reduction, a key consideration in risk assessment uncertainty analysis.

Originally, CLP protocols were established by the USEPA for administrative purposes to assist the USEPA in the bid process for contracted CERCLA work through the establishment of standardized scope of work, to provide consistency between projects and to facilitate cost recovery for activities conducted under CERCLA. For the Phase 2 RI/FS at the BROS Superfund site, these primary objectives of the CLP process have been satisfied or are no longer relevant. A laboratory procurement process was conducted that involved competitive bidding on

a common scope of work to provide a consistent basis for evaluation of the technical and cost elements of the various proposals. All of the bidders were capable of meeting the CLP program requirements if required and the quality of work was consistent with the requirements of the Consent Decree and with other CERCLA projects. The use of USEPA-approved methods and potential method improvements will further ensure consistent data quality to the degree practical, given the established matrix complexities unique to the site. Finally, as the Consent Decree clearly establishes the funding necessary for completion of the Phase 2 RI/FS and remedial actions. It also provides a mechanism for USEPA disallowance of costs incurred, USEPA's cost recovery concerns are mitigated.

USEPA SW-846 methodologies will be used exclusively for analysis of samples collected from the BROS site for VOCs, SVOCs, PCBs and TAL metals. Although the numeric DQOs could be achieved for a small percentage of samples if CLP methodologies were used, the mixing of CLP and USEPA SW-846 methodologies is undesirable from a data comparability perspective. Sample extract cleanup procedures and method modifications consistent with USEPA SW-846 methodologies will be needed for most of the samples collected during the Phase 2 RI/FS, especially those collected on and near the BROS property and for all sediment samples where matrix interference is likely. To fully understand the extent of matrix interference effects, the results of samples collected from the BROS site will be compared to samples collected from offsite/background areas. The use of different analytical methodologies for samples collected from the BROS site and samples collected from off-site/background areas will reduce the effectiveness of the comparison. Furthermore, the use of different analytical methodologies will cause confusion when assessing data usability for risk assessment purposes. Separate acceptance criteria would have to be established for each analytical protocol. The use of separate acceptance criteria would increase the rate of decision error by unnecessarily over complicating the data usability process. To accommodate the use of SW-846 methodologies, site-specific data validation criteria have been established. These criteria are based upon the standard USEPA Region II data validation procedures and are detailed in Section 14.0.

The use of the planned laboratory methods and the detailed sampling procedures in the SAP is designed to generate data of sufficient quality (i.e. with low enough error) for use in meeting the

study objectives. The primary data quality objective support the risk assessment/remedial alternative evaluations and can be met through the use of these protocols. This is because the quantitative data from the RI can be used to establish gradients to identify the distribution of COPCs and because the numeric DQOs (Section 4.0) selected for the project were developed using health based criteria and are protective of human health and the environment. Furthermore, the use of USEPA SW-846 methods provides for the flexibility to address the anticipated complexities associated with different matrixes and sampling complexities.

Preliminary numeric DQOs, based on PRGs, have been developed for soils, ground water, surface water, sediment (Tables 1A through 1D), as described in the previous section.

3.4 Project Schedule

A project schedule which includes the schedule for sampling, is provided as Plate 1.

4.0 QUALITY ASSURANCE OBJECTIVES AND CRITERIA FOR MEASUREMENT DATA

Data Quality Objectives have been developed for the Phase 2 RI/FS based upon the intended uses of the data and a recognition of the matrix complexities and limitations particular to the site. The DQOs were developed within the context of relevant guidance including the *EPA Requirements for Quality Assurance Project Plans for Environmental Data Operations* (EPA QA/R-5), the *USEPA Region II CERCLA Quality Assurance Manual*, and the *Guidance for the Data Quality Objectives Process* (EPA QA/G-4). The primary intended uses for RI data are for risk assessment and evaluation of remedial alternatives. Specifically, the DQOs are the ability to use the data for comparison to risk-based remedial action criteria, including PRGs, ARARs and TBCs, and to support the estimation of COPC concentrations at the point of exposure. These data uses can be achieved using DQOs for laboratory data that are approximately 50 percent of the PRG. DQOs for field screening data are established to ensure the safety of site workers and to provide meaningful data for the selection of site characterization samples and the assessment of the representativeness of sampling results.

DQOs for field screening, monitoring and field testing and laboratory analytical data are described below.

4.1 DQOs for Monitoring, Field Screening, and Field Testing

Field measurements will be taken to assist in the selection of soil, ground water and surface water samples. Additionally, organic vapor monitoring will be conducted for health and safety purposes. DQOs for these measurements need to be stringent enough to accurately characterize site conditions to support sample collection activities and be protective of the health and safety of the field team based upon the action levels established in the HASCP.

A photoionization detector (PID) or flame ionization detector (FID) will be used for field screening and air monitoring. The DQO for the PID/FID will be 1.0 part per million (ppm). To achieve this DQO, the PID/FID will be operated and calibrated in accordance with the manufacturers' specifications.

To measure the ferrous iron content in ground water samples at the time of collection HACH field test kits will be used. The DQO for these test kits is 5 ppm. To achieve this DQO the procedures documented in the manufacturer's instructions will be followed.

Other field parameters that will be measured for surface water and ground water include pH, Eh, dissolved oxygen (DO), temperature, and specific conductance. The data quality objectives for each parameter is described below:

pH - 0.1 standard unit;
Eh - 1.0 microvolt;
DO - 0.1 ppm;
temperature - 0.1 degrees centigrade; and
specific conductance - 10 microsiemens.

To achieve these DQOs the instruments will be calibrated and operated in accordance with the manufacturer's specifications.

4.2 Laboratory Analytical DQOs

4.2.1 Off-Site Laboratory

Due to the nature of the media and contaminants at the BROS Superfund Site it is likely that minimum detection limits for many analyses are not achievable using CLP or USEPA SW-846 methodologies. This condition has been recognized and the Consent Decree stipulates that the PRPs may develop ADQOs, subject to approval by the USEPA. Furthermore, such low detection limits are not necessary for decision making at this site. The rationale for development of the site-specific DQOs is provided below.

The DQOs selected for the site must allow the data to be used for the following purposes:

- site characterization;
- risk assessment;
- evaluating potential remedial alternatives; and

- conceptual engineering design during the FS.

Within the context of the risk assessment and the FS, laboratory data will be used for estimating the volumes and distributions of COPCs through the use of interpolation and extrapolation along gradients. These results will then be used to calculate probable concentrations of exposure (with subsequent comparison to PRGs and other risk-based objectives) and to estimate restoration times for different alternatives.

DQOs for the risk assessment have been established to ensure that representative data are collected for realistic exposure scenarios. The site complexities and matrix interference's associated with analysis of soil, sediment and lagoon residual samples warrant the use of site-specific numeric DQOs. These modifications should not impact the usability of the data for risk assessment and remedial alternatives analysis purposes, provided the numeric DQO target of 50 percent of the PRG is met on the majority of samples. The concerns for matrix interference are most acute for the wetlands samples. As the ecological risk assessment will integrate both quantitative (i.e. bottom up) and qualitative (i.e. top down) methodologies, the alternative DQOs will allow for the development and interpretation of risk-based remedial action strategies.

To ensure that data quality needs are met and above objectives are achieved, the proposed numeric DQOs for laboratory analytical methods are 50 percent of the PRGs, with the exception of selected COPCs in ground water that have standards based on the PQLs and where PRGs are below the PQL or MDL. In these instances, the PRG will be the MDL. The most stringent DQOs are for residential well sampling based upon risk assessment objectives and the importance of providing accurate data to the property owner. For these compounds the DQOs will be the PQLs.

To achieve these numeric DQOs, USEPA SW-846 methodologies will be used, where applicable, as they have lower MDLs than the CLP methods and more applicable quality control, as described above. For non-conventional analyses, other published sources will be used such as American Society for Testing and Materials (ASTM) methodologies will be used.

4.2.2 On-Site Laboratory

An on-site laboratory will be used for the testing of soils, sediments, ground water and investigation-derived wastes (e.g. development water, drill cuttings). Soil samples will be analyzed for volatile organic compounds, lead and total petroleum hydrocarbons (TPH) using the on-site laboratory. The on-site testing of soil samples will be used to select samples for off-site laboratory analysis and to establish gradients of contaminants for use in preliminarily establishing the distribution of contaminants at the site. Analysis for VOCs by SW-846 method 8260B, TPH using a modified version of SW-846 method 8015, and lead by x-ray fluorescence within the field screening plan will provide: an indicator of the relatively more mobile contaminants (i.e., VOCs); and a broader indicator of petroleum-related contaminants, consistent with the chemicals processed at the site and the compounds detected in previous investigations. These data will provide a basis for establishing contaminant gradients and the approximate perimeter of the site in the swamp. Accordingly, samples will be selected for off-site analyses. SOPs for the analyses that will be performed by the on-site laboratory are provided in the laboratory's QA Plan (Volume 2 of 2 of Attachment 1 of this QAPP). QA/QC sample analysis that will be conducted by the on-site laboratory is detailed in Table 2-1 of the laboratory's QA Plan (Volume 2 of 2 of Attachment 1 of this QAPP).

The laboratory analytical DQOs for the New Jersey-certified analyses that the off-site laboratory will perform are the same as the DQOs for the off-site laboratory described in Section 4.2.1. New Jersey-certified analyses that the on-site laboratory may perform include:

- VOCs;
- PCBs;
- SVOCs; and
- TPH.

Data generated for non-certified analyses will meet the specifications of On-Site Laboratories' Level III data quality package which conforms to Data Quality Level 2 as specified in the NJDEP *Field Analysis Manual* (NJDEP, 1994). Relevant requirements of Data Quality Level 2 methods are that they:

- provide reliable rapid contaminant delineation;
- have a high degree of reproducibility when QA/QC procedures are employed;
- are typically standard laboratory methods which have been adapted for field use; and
- are quantitative.

4.3 Accuracy, Precision, and Sensitivity of Analysis

The fundamental QA objective with respect to accuracy, precision, and sensitivity of laboratory analytical data is to achieve the QC acceptance criteria of the analytical protocols.

Accuracy, precision and completeness requirements will be addressed for all the data generated. Accuracy, the ability to obtain a true value, is monitored through the use of field and method blanks, spikes, and standards; and compared to federal and state regulations and guidelines. This will reflect the impact of matrix interference's. Precision, the ability to replicate a value, is monitored through duplicate (replicate) samples. Precision is assessed for each matrix. Corrective actions and documentation for substandard recoveries, or substandard precision, must be performed by the laboratory. These parameters will be based on analysis method criteria. Refer to Attachment 1 for the specific method precision and accuracy limits for each laboratory.

Instrument sensitivity must be monitored to ensure the data quality through constant instrument performance. Method detection limits depend on instrument sensitivity and matrix effects. Monitoring of instrument sensitivity is performed through the analysis of reagent blanks, near detection limit standards, and response factors.

Field and laboratory QC samples and frequencies required to achieve the desired data quality are summarized in Tables 4 and 5, respectively.

4.4 Completeness, Representativeness and Comparability

Completeness is a measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under normal conditions. It is estimated that the laboratory will provide data meeting QC acceptance criteria for 90 percent of all samples, except where substandard QC is achieved due to matrix interferences. Following

completion of the analytical testing, the percent completeness will be calculated by using the equations presented in section 15.0.

Representativeness expresses the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition. Representativeness is a qualitative parameter which is dependent upon the proper design of the sampling program and proper laboratory protocol. The sampling network was designed to provide data representative of site conditions. During development of this network, consideration was given to past waste disposal practices, existing analytical data, and physical setting and processes. The rationale of the sampling network is discussed in detail in the Work Plan. Representativeness will be satisfied by ensuring that the Sampling and Analysis Plan (SAP) is followed, proper sampling techniques are used, proper analytical procedures are followed and holding times of the samples are not exceeded in the laboratory. Representativeness will be assessed in part by the analysis of field duplicate samples.

Comparability expresses the confidence with which one data set can be compared with another. The extent to which existing and planned analytical data will be comparable depends on the similarity of sampling and analytical methods. The procedures used to obtain the planned analytical data, as documented in the QAPP, are expected to provide comparable data.

5.0 SAMPLING PROCESS DESIGN AND METHOD REQUIREMENTS

The format and content of this QAPP were specified in the Consent Decree (USDC, 1996) so that the format of this QAPP does not match the specific format of QA/R-5. However, to facilitate location of the QA/R-5 components in this QAPP, a cross-walk between the relevant sections of this QAPP and the format specified in QA/R-5 has been provided (Appendix A). A summary of the objectives, scope and methods of the Phase 2 RI/FS is provided in Appendix B. This information was incorporated from the Work Plan and the SAP to provide reference information consistent with the specifications of QA/R-5 and includes the following:

- a discussion of each of the Phase 2 RI/FS objectives and associated data needs to accomplish the objectives;
- a summary of the proposed Phase 2 RI/FS Scope of Work;
- tables indicating the number of samples, associated analytes, and the rationale for the selection of the sampling locations and sampling intervals; and
- figures showing the location of the sampling points.

More detailed discussions of the Phase 2 RI/FS objectives, methods and scope of work are provided in the Work Plan and SAP.

Detailed sampling procedures are provided in the SAP and describe the sampling and data gathering methods. The laboratory methods that will be used to analyze the samples collected from the site are provided in Table 5 and the laboratory SOPs for these methods are provided in Attachment 1. A summary of sample containers, preservation, and holding times has been prepared (Table 6). For the planned tasks (i.e., soil sampling, monitoring well installation, ground water sampling, sediment sampling, surface water sampling, and ecological sampling), the SAP includes the following:

- description of the source matrix and sampling procedures;
- description of containers, preservation, holding times, etc., used in sample collection, transport, and storage;
- procedures for decontamination of equipment; and
- chain of custody procedures.

Previous investigations conducted at the site indicated the presence of acetone, methylene chloride and carbon disulfide in numerous samples, especially those collected near Monitoring Well S-11C. It is uncertain to what extent the presence of these compounds in the laboratory results can be attributed to cross-contamination in the field or laboratory, although the results between sampling rounds were variable. Field and laboratory personnel will be reminded to take care during equipment decontamination and sample handling in order to reduce the possibility of cross-contamination of samples. For samples collected near S-11C, a notice will be entered on the chain of custody forms to alert the laboratory to take additional precautions with these samples.

A thorough review of blank results will be conducted, by a party other than the analytical lab, as a component of the data evaluation process. The data review procedures are based upon the data validation guidelines presented in Section 14.0 of this QAPP. The results of the method, trip and field blanks for organic data will be reviewed and the appropriate data will be qualified as discussed below. If any compound is detected in the sample and in any of the associated blank samples, the result will be qualified with a "B" when the sample result is at a concentration at less than 5 times the blank concentration. For common laboratory contaminants, the results will be qualified with a "B" when the sample concentration is less than 10 times the blank concentration. Compounds considered common laboratory contaminants include acetone, methylene chloride, and 2-butanone and the various phthalates. If a compound is detected in a blank, but not in the associated sample, the data will not be qualified.

The results of laboratory and field blank analyses for inorganic data will also, consistent with *Evaluation of Metals Data for the Contract Laboratory Program (Revision 11)*, January, 1992 (USEPA, 1992a), be reviewed, and the data will be qualified when necessary, as discussed below. For inorganic data, laboratory blank samples include method blanks, initial calibration blanks, and continuing calibration blanks. For all laboratory blanks with detections, a "data quality action level" of five times the blank value will be determined for each analyte. Corresponding RI samples with the result less than the action level will be qualified with a "B". If the corresponding analyte in the RI sample is not detected by the laboratory, no qualifier will be assigned. If the corresponding RI sample result exceeded the action level, the result will be reported with no qualifier. After all samples and field blank samples are qualified, the RI sample results will be further qualified based on field blank results. If a metal is detected in a field blank sample, the results for the associated RI samples greater than the limit of quantitation (LOQ) but less than five times the field blank concentration will be qualified with a "B".

Insect/tick repellent will be used for health and safety purposes by field personnel during all data gathering activities. Care will be taken by the field personnel to avoid cross-contamination of samples with insect/tick repellent through the judicious application of the repellent and care in avoiding contact between the repellent and sampling equipment. Field personnel are reminded to use repellent according to the manufacturer's directions and to replace gloves or equipment if they come in contact with repellents or clothing that has been treated with repellents. The use of repellents will be noted in the field log.

The primary DQOs have been established for risk assessment and remedial alternatives evaluation purposes. The primary Phase 2 RI/FS objectives are the evaluation of remedial alternatives for ground water and wetlands. Based upon these project objectives and DQOs, the primary data gaps relative to soils are (1) the evaluation of the distribution of LNAPL and (2) the presence of chlorinated volatile organic compounds in suspected source areas where preliminary data has already been collected. As such, the Phase 2 RI/FS will be building upon a substantial volume of previously collected data, including an extensive soils investigation conducted by the USEPA between November 1996 and January 1997. A primary objective of the Phase 2 RI/FS is the use of existing data (Consent Decree, Appendix E) to the degree practical. However, soil

samples collected for volatile organic compound analysis during previous phases of investigation were not preserved using methanol.

As N.J.A.C. 7:26E currently requires methanol preservation of soil samples and the USEPA has also recommended the use of methanol preservation, a comparability study of methods was conducted (Roux, 1999). The comparability study consisted of the analysis of select soil samples for VOCs using methanol-preserved samples (SW-846 5035 High Level), samples collected using the Encore™ sampling method (SW-846 5035 Low Level) and preserved by freezing in deionized water; and traditional ice-preserved samples (SW-846 5030), collected from the same location.

The analysis of the sediment samples using the traditional VOC sampling method indicated that the numeric DQOs were achievable. The laboratory reported that the sediment samples collected using the Encore™ sampler could not be preserved using sodium bisulfate due to effervescence; therefore, they were preserved in deionized water and frozen in accordance with USEPA guidance (USEPA, 1998d). The numeric DQOs for sediments were achieved using the Encore™ sampling method and several compounds were detected that were not detected using the traditional VOC sampling and preservation methods indicating that there are less sample collection VOC losses using the Encore™ method. The reporting limits for numerous VOCs using the NJDEP methanol preservation method were elevated above the numeric DQOs due to the dilution inherent in the method (a dilution factor of 125).

As the numeric DQOs were met using the Encore™ sampling method, several compounds were detected using the Encore™ sampling method that were not detected using traditional sampling methods, and the inability of the NJDEP methanol preservation method to achieved the desired DQOs; the Encore™ sampling method was selected for collection of sediment samples. The sampling method should be modified to include the use of a stainless steel spoon to assist in filling the Encore™ sampler to ensure that adequate sample weight is collected and that the sample container can be closed as quickly as possible. The laboratory should preserve the samples by freezing in distilled water rather than using sodium bisulfate to prevent

effervescence. These finding are presented in detailed in Technical Memorandum Number 2 and have been approved for use by the USEPA in their letter dated May 4, 1999.

6.0 SAMPLE HANDLING AND CUSTODY REQUIREMENTS

The possession and proper transfer of samples and sample-related information must be traceable from the time the samples are collected until the data have been accepted for analysis. The Work Plan describes the procedures for sample custody from the point where the sample is collected through the laboratory analysis. The following sections summarize the general aspects of custody and how they will be applied and managed during the course of the project and are consistent with the *Technical Requirements for Site Remediation* at N.J.A.C. 7:26E and the NJDEP's *Field Samplings and Procedures Manual*.

A sample or sample-related information (sample or evidence file) is under your custody if it:

- is in your possession;
- is in your view, after being in your possession;
- is in your possession and you place them in a secured location; or
- is in a secured, designated place.

6.1 Field Chain of Custody Procedures

The sample labeling, packaging and shipment procedures summarized below will ensure that the samples will arrive at the laboratory with the chain of custody intact.

6.1.1 Sample Designation

Sample bottles (including those containing preservatives, where necessary), labels, shipping containers, trip blanks, and field blank water will be provided by the laboratory. Examples of completed sample labels are illustrated in Figure 2. During collection of soil and sediment samples, the sample container will be labeled with the following information:

- site identifier (BROS);
- Roux Associates, Inc.'s project number;
- sample location identifier and field quality control (QC) identifier (if applicable);
- sample type (media) and identification code;

- sample depth and analysis identifier;
- date and time of collection;
- type of preservative added (if applicable);
- sample collector's initials.

During collection of ground water samples, the sample containers will be labeled with the following information:

- site identifier (BROS);
- Roux Associates, Inc.'s project number;
- sample location identifier, and field QC identifier (if applicable);
- sample type (media) identification code;
- date and time of collection;
- field handling (e.g., filtration); and
- type of preservative added (if applicable).

1. The sample identification code provided on each sample label will include the sample location/sample type/depth interval (soil and sediment samples only)/QC qualifiers using the abbreviations presented below.

Sample location abbreviations will be as presented below.

former lagoon area soil boring = L followed by the designated boring number.

former process area soil boring = P followed by the designated boring number.

Pepper Building boring = PB followed by the designated boring number.

monitoring well I.D. = MW followed by the designated well number.

monitoring well constructed using alternative methods = WMW followed by the designated well point number.

Gaventa Pond sediment/surface water samples = GVT followed by the designated sample location number.

Little Timber Creek and Cedar Swamp sediment/surface water samples = LTC followed by the designated sample location number.

2. Sample type (media) abbreviations will be as presented below.

surface water sample = SW
ground water sample = GW
soil sample = SO
sediment sample = SED
non aqueous phase liquid = NAPL

3. Depth intervals will be designated in feet or tenths of a foot (e.g., 0.1, 1.0, etc.).

4. QC identifiers will be as follows:

Trip blank = TB

Field blank = FB

Matrix Spike and Matrix Spike Duplicate = MS/MSD

Filtered water samples = F

For example, the designation "L-8/SO/12-14" would indicate that the sample was collected at former lagoon area soil boring L-8, that it was a soil sample, and that it was collected at a depth interval of 12 feet (ft) to 14 ft below land surface (Figure 2). A sample designation "MW-10/GW/F" would indicate a filtered ground water sample collected from Monitoring Well MW-10 (Figure 16).

Field replicates will be provided with discrete sample numbers and not designated with an "R". Field replicates should be designated sequentially starting with A-1. It is necessary to record the replicate pairs in the field logbook. An example designation for a replicate sample would be "A-23/SED/0-1", which would indicate a replicate sediment sample collected from the 0 to 1 inch depth interval.

6.1.2 Field Procedures

- a) The field sampler is responsible for the care and custody of the samples until they are transferred or properly dispatched. As few people as possible should handle the samples.

- b) All bottles will be labeled with the appropriate sample numbers as described above.
- c) Sample labels are to be completed for each sample using waterproof ink unless prohibited by weather conditions. For example, a logbook notation would explain that a pencil was used to fill out the sample tag because the ball-point pen would not function in freezing weather.
- d) The Field Team Leader will review all field activities to determine whether proper custody procedures were followed during the field work and decide if additional samples are required.

6.1.3 Field Logbooks/Documentation

Field logbooks will be used to document all data collection activities performed in the field. As such, entries will be described in sufficient detail such that persons going to the site could reconstruct a particular situation without reliance on memory. A summary of field documentation requirements is presented below.

Field logbooks will be bound field survey books or notebooks. Logbooks will be assigned to field personnel, but will be stored in the document control area when not in use. Each logbook will be identified by the project-specific document number.

The title page of each logbook will contain the following:

- person to whom the logbook is assigned;
- logbook number;
- project name;
- project start date; and
- end date.

At the beginning of each entry, the date, start time, weather, names of all sampling team members present, level of personal protection being used, and the signature of the person making

the entry will be entered into the field book. The names of visitors to the site, field sampling or investigation team personnel and the purpose of their visit will also be recorded in the field logbook.

Measurements made and samples collected will be recorded. All entries will be made in ink (if possible) and no erasures will be made. If an incorrect entry is made, the information will be crossed out with a single strike mark and initialed by the person making the correction. Whenever a sample is collected, or a measurement is made, a detailed description of the location of the station shall be recorded. The number of the photographs taken of the station, if any, will also be noted. All equipment used to make measurements will be identified, along with the date of calibration. Additional field instrument calibration information that will be recorded in the field book includes a description the calibration standard, the instrument span setting and the instrument reading obtained after the calibration procedure is completed.

Samples will be collected following the sampling procedures documented in the SAP. The equipment used to collect samples will be noted, along with the time of sampling, sample description, depth at which the sample was collected, sample volume and number of containers. Sample identification numbers will be assigned prior to sample collection. Field duplicate samples, which will receive an entirely separate sample identification number, will be noted under sample description (in the field log books but not the chain of custody).

6.1.4 Transfer of Custody and Shipment Procedures

- a) Samples will be accompanied by a properly completed chain of custody form. The sample numbers, location code (including sample depths), time of collection, and analysis requested will be listed on the chain of custody form. When transferring the possession of samples, the individuals relinquishing and receiving will sign, date, and note the time on the record. This record documents transfer of custody of samples from the sampler to another person, to a mobile laboratory, to the permanent laboratory, or to/from a secure storage area.

- b) Samples will be properly packaged for shipment and dispatched to the appropriate laboratory for analysis, with a separate, signed custody record enclosed in or on each sample box or cooler. Shipping containers will be locked and secured with strapping tape and USEPA custody seals for shipment to the laboratory. The preferred procedure includes use of a custody seal attached to the front right and back left of the cooler. The
- c) custody seals are covered with clear plastic tape. The cooler is strapped shut with strapping tape in at least two locations.
- d) Whenever samples are split with another source (i.e., a government agency), a separate sample receipt is prepared for those samples and marked to indicate with whom the samples are being split. The person relinquishing the samples to the facility or agency should request the representative's signature acknowledging sample receipt. If the representative is unavailable or refuses, this is noted in the "Received By" space.
- e) All shipments will be accompanied by the chain of custody record identifying the contents. The original record will accompany the shipment, and the pink and yellow copies will be retained by the sampler for returning to the sampling office. Photocopies of the original record should be made before shipment, if possible, to ensure that clean copies can be made later.
- f) If the samples are sent by common carrier, a bill of lading (airbill) must be used. Receipts of bills of lading will be retained as part of the permanent documentation. If sent by mail, the package will be registered with return receipt requested. Commercial carriers are not required to sign off on the custody form as long as the custody forms are sealed inside or on the outside of the sample cooler and the custody seals remain intact.

6.2 Laboratory Chain of Custody Procedures

Laboratory custody procedures for sample receiving and log-in, sample storage, tracking during sample preparation and analysis, and storage of data are described in detail for each laboratory in the laboratory QA plans in Attachment 1. All sample container preparation, shipping, laboratory handling of samples, and custody procedures will conform to USEPA and NJDEP requirements.

Upon receipt of samples at the laboratory, the sample custodian will review and record the sample condition (including temperature) and sign the chain-of-custody as acceptance of the samples by the laboratory. The laboratory will notify Roux Associates, Inc. within 24 hours from sample receipt of broken or missing samples, or samples not received within $4^{\circ}\text{C} \pm 2^{\circ}\text{C}$.

Refer to Attachment 1, Laboratory QAPP and SOPs for each laboratory's sample handling procedures.

7.0 ANALYTICAL METHOD REQUIREMENTS

Analytical procedures for this project have been selected to generate data meeting the DQOs required for the scope of work. A summary of the methods chosen and the rationale for each method selected is presented below. These methods are summarized in Table 5. Sampling methods and procedures applicable to health and safety (e.g., personnel monitoring) are described in the HASP.

7.1 Laboratory Parameters

Methods published by USEPA will be used as the basis for all analyses for which such methods exist. The laboratory will follow methods detailed in *Test Methods for Evaluating Solid Waste – Physical/Chemical Methods*, USEPA SW-846, 3rd Edition, Update III, December 1996, *Methods for Chemical Analysis of Water and Wastes*, (EPA 600/4-79-020, EPA 600/R-95-131), or the most recent revisions of these documents. Where USEPA methods do not exist, ASTM, *Standard Methods for the Evaluation of Water and Waste Water*, or equivalent will be used. The NJDEP's methodology for the field preservation of soil samples will be used for all soil samples collected from the site that will be analyzed for VOCs. Additional detail about method modifications is provided in Section 7.5. A summary of the methods to be used by the off-site laboratories is provided in Table 5. The on-site laboratory will use the following methods for the testing of soils, sediments, ground water and investigation-derived wastes (e.g. development water, drill cuttings):

- volatile organic compounds by SW-846 method 8260B;
- lead by x-ray fluorescence; and
- TPH using a modified version of SW-846 method 8015.

The SOPs for the analyses that will be performed by the on-site laboratory are provided in the laboratory's QA Plan (Volume 2 of 2 of Attachment 1 of this QAPP).

The use of USEPA SW-846 methods will provide the laboratory with greater flexibility in methodology and cleanup procedures which, in the experience of the laboratories, will enable the laboratories to achieve lower detection limits and a higher percentage usable data that are more consistent with the project DQOs. Information pertaining to the use of available sample extract cleanup methods is detailed in *Technical Memorandum Number 2 - Analytical Method Development Study* (Roux, 1999). The laboratories will follow USEPA SW-846 methods while maintaining consistency with CLP deliverables, to the extent practical. Elements that are required for a CLP data package and that will be included in the USEPA SW-846 data packages prepared for the BROS site include the following:

- title page
- case narrative,
- sample analysis request form,
- field chain of custody
- laboratory chronicle
- method summary
- method references
- sample data
 - analysis reports
 - all raw sample data including instrument printouts
 - MDLs
- quality Control Summary
 - duplicate, matrix spike, matrix spike duplicate, blank, and LCS, if applicable, and surrogate recovery summary forms
 - GC/MS tuning summary
- standard Data
 - initial and continuing calibration summary forms
 - all raw initial and continuing calibrations and standardization data including instrument printouts
- quality control raw data

- all raw quality control sample data including printouts
- extraction log
- run log

To provide additional similarity to CLP data packages, the results for all VOC, SVOC, TAL metals, pesticide and PCB analyses will be reported, to the degree practical, on a CLP Form I with equivalent CLP data flags. All other analyses will be reported in a format and level of supporting documentation consistent with the applicable USEPA Region II data validation criteria.

7.2 Field Parameters

The procedures for field measurement of pH, Eh, specific conductance, temperature, dissolved oxygen (DO), and organic vapors (PID), and for field measurement of ferrous iron are described in the SOPs in the SAP. Method references are included in Table 5.

Portable probes operated according to the manufacturer's instructions and the Roux Associates, Inc.'s SOPs will be used for specific conductance, temperature, Eh, DO, and pH. For these field measurements, ground water will be collected and transferred into clean containers. The separate conductivity and temperature/pH/Eh probes will be inserted into the containers and allowed to equilibrate prior to recording the readings. In accordance with NJDEP requirements, measurements for DO, pH, specific conductance and temperature conducted in the field will be performed by a New Jersey certified laboratory, using NJDEP-approved procedures.

7.3 Analytical Quality Control

The analytical measurement QC for field and laboratory analyses will generally address the parameters of precision and accuracy. The required QC sample types, frequency and acceptance criteria for the field and laboratory measurements are summarized in Tables 4 and 5. Assessment of data quality based on the QC results is part of the data validation process and is discussed in Sections 14.0 and 15.0.

7.4 Proposed Analytical Laboratories

All analytical laboratories used for this work will meet the requirements of the respective laboratory QA plan and any other requirements for performing analyses to meet the required DQOs. The laboratories will be New Jersey-certified to perform the analyses specified, where such certification applies. Roux Associates, Inc. is in the process of obtaining New Jersey certification for DO, pH, specific conductance and temperature. This certification is expected prior to field sampling. Alternatively, OnSite can provide these New Jersey-certified analyses and may be used for these activities. The SOPs associated with the field measurement of DO, pH, specific conductance and temperature will be consistent with those outlined by OnSite in Attachment 1. The laboratory qualifications statement(s) and/or QA plan for LLI and OnSite are included in Attachment 1.

The QAPP material and the specific method SOPs are provided by each laboratory conducting analyses. LLI will be responsible for the off-site sample analysis and OnSite will be responsible for the mobile (on-site) laboratory portion of this project. Two off-site laboratories were originally selected for the project so analytical services can be matched to each of the laboratory's strengths and to provide backup capability when needed. However, the previously selected backup laboratory has decided not to participate in the project. As such, LLI will be tasked with the analysis of all samples collected from the site until a backup laboratory can be selected. The onsite laboratory will be used to screen samples to optimize the collection of samples for field analysis, screening of investigation derived waste from off-site areas, and to provide rapid turnaround times to support drilling activities.

LLI will be the lead laboratory and initially will be responsible for the analysis of all site samples. However, even after a laboratory is selected to serve as a backup to LLI, LLI will continue to be responsible for the analysis of the majority of the following types of samples:

- soil samples;
- sediment samples;
- surface water samples; and
- ground water samples.

A second laboratory may be selected as the backup/specialty analysis laboratory and would be responsible for the analysis of samples. During times of intense sampling activities where the number of samples collected on a daily basis exceeds LLI's capacity, the overflow will be directed to the backup laboratory.

OnSite has been selected as the on-site lab and will be responsible for the following:

- the analysis of ground water samples collected from slotted augers;
- screening of initial sediment samples collected from Little Creek Swamp for TPH and lead to optimize sampling locations for off-site laboratory analyses;
- screening soil samples to assist in the selection of samples for laboratory; and
- screening investigation derived wastes generated at off-site locations to assist in the evaluation of disposal requirements.

7.5 Rationale for Analytical Method Selection

The proposed analytical methods were selected to more fully characterize the nature and distribution of COPCs throughout the various media present at site; evaluate the fate and transport of COPCs within the various media; characterize potential exposure point concentrations; classify investigation-derived wastes and potential waste streams that may be generated during the remedial activities at the site, and support the selection of remedial alternatives. The types of analytical methods that will be used during the course of the investigation and include:

- methods that measure the concentrations of selected compounds (VOCs, PCBs, pesticides, TAL Metals, TPH, and SVOCs) present in the various media;
- methods that measure the geochemical (e.g. TOC and CEC) and geotechnical properties (e.g. permeability and particle size distribution) of the various media that will be used to

evaluate the fate and transport of COPCs within the various media and assist in the evaluation of remedial alternatives;

- methods, such as SPLP VOCs and metals, that will be used to assess COPC partitioning, relative mobility potential, and restoration timeframes;
- methods that characterize wastes (e.g. ignitability, corrosivity, reactivity, TCLP VOCs, TCLP Metals, and TCLP SVOCs) that will be used to evaluate potential disposal options for the investigation derived wastes and potential remedial options; and
- field screening methods (e.g. VOCs, TPH and lead) that will be performed using an on-site laboratory to measure the concentrations of selected compounds and to screen investigation-derived waste to determine if special handling procedures are required.

All analytical methods selected for use during this project have been chosen based upon the following criteria:

- ability of the methods to meet the established data quality objectives for the project;
- validity and reproducibility of the method;
- the outcome of the seven step DQO process provided in Section 3.2 of this document;
- the ability of the methods to meet the required numeric DQOs;
- the flexibility of the methods to accommodate the use of sample extract cleanup procedures and method modifications to achieve lower detection limits in samples where matrix interference is likely;
- conformance of the method to standard USEPA methods and practices; and
- cost comparison between the method alternatives (if applicable).

After reviewing these criteria, the analytical methods summarized in Table 5 were chosen for this project. The rationale for choosing the specific analysis method is presented below for field and laboratory analyses.

Physical Analysis of Water Samples

Water samples requiring analyses for pH, temperature, specific conductance and do will be analyzed using Roux Associates, Inc.'s SOPs and State-laboratory certification protocols and/or manufacturer's specifications which are based upon the published USEPA and New Jersey Department of Environmental Protection (NJDEP) methods for water. These analyses will be performed to provide supplementary and background data for off-site laboratory analyses and to assist in the overall water-quality characterization. Ferrous iron will be analyzed using the HACH Iron Test Kit. The procedures for this analysis are provided in Appendix D. Data generated through the use of these methods will meet or exceed the established task-specific data needs/uses.

Chemical Analysis of Water Samples

Water samples requiring chemical analyses for TCL VOCs, SVOCs, PCBs, GRO (Gasoline Range Organics), DRO (Diesel Range Organics) and TAL metals will be analyzed using USEPA SW-846 methodologies. Wet Chemistry parameters such as nitrate, nitrite, orthophosphate, sulfide, and sulfate will be analyzed using *Methods for Chemical Analysis of Water and Wastes*, (EPA 600/4-79-020, EPA 600/R-95-131), or the most recent revisions of these standards. For organic analysis and inorganic analysis, USEPA SW-846 methodologies were selected over CLP methodologies for the following reasons:

- the ability to achieve lower MDLs, which is an important factor in data usability in the risk assessment;
- more applicable quality control procedures based upon the anticipated concerns for matrix interference;
- the ability to apply sample extract cleanup methods as detailed below; and

- USEPA SW-846 methods provide for the use of selected ion monitoring (SIM) to achieve lower detection limits, if warranted.

These analyses will be performed to provide information regarding site characterization, remedial alternatives, and risk assessment. The waste disposal parameters, Gasoline Range Organics/Diesel Range Organics (GRO/DRO), will be analyzed using the USEPA SW-846 methodologies, and the geochemical analyses will be performed using Methods for the Examination of Water and Wastewater. Carbon dioxide and the light hydrocarbons ethane, ethane, and methane will be analyzed using modified versions of USEPA SW-846 8000. Hydrogen sulfide will be analyzed using a combination of SW-846 methods 3810 and modified 8015. The SOPs for the modified versions of USEPA SW-846 Method 8000 that will be used to analyze for carbon dioxide and the light hydrocarbons and USEPA SW-846 Method 8015 that will be used to analyze for hydrogen sulfide, along with the associated control charts for these modified methods, are provided in Volume 1 of 2 of Attachment 1. British Thermal Unit (BTU) analysis will follow ASTM protocols. Data generated through the use of these methods will meet or exceed the established task-specific data needs/uses.

Sample extract cleanup procedures will be employed to minimize the effects of matrix interference for samples analyzed for PCBs. The florisil cleanup procedure (SW-846 Method 3620B) and the sulfuric acid cleanup procedure (SW-846 Method 3665A) will be used on water samples analyzed for PCBs. These cleanup procedures were proven to effectively reduce site related matrix interference effects during the Analytical Method Development Study (Roux, 1999).

Chemical Analysis of Soil Samples

Soil samples requiring chemical analyses for TCL VOCs, TCL SVOCs, PCBs, pesticides, GRO, DRO, total petroleum hydrocarbons (TPH), pH, TOC, cation exchange capacity, waste disposal parameters and TAL metals will be analyzed using USEPA SW-846 methodologies, for the reasons enumerated above. The USEPA SW-846 methodologies analyses will be used for site characterization, and to support the risk assessment and the analysis of remedial alternatives.

Data generated through the use of these methods will meet or exceed the established task-specific data needs/uses.

Sample extract cleanup procedures will be employed to minimize the effects of matrix interference as described below:

- For SVOC analyses the gel permeation chromatograph cleanup procedure (SW-846 Method 3640A) will be used on all soil and sediment samples.
- For PCBs the florisil cleanup procedure (SW-846 Method 3620B) and the sulfuric acid cleanup procedure (SW-846 Method 3665A) will be used on all soil and sediment samples. Additionally the sulfur cleanup procedure (SW-846 Method 3660B) will be used on sediment samples collected from the *de manifestis* and intermediate zones and soil samples collected from close proximity to the lagoon.

These cleanup procedures were confirmed to effectively reduce site related matrix interference effects during the Analytical Method Development Study (Roux, 1999).

Select soil samples will be subjected to analysis by USEPA SW-846 Method 1312, the synthetic precipitation leaching procedure (SPLP). Extract from this procedure will be analyzed for VOCs and TAL metals according to SW-846 methodologies. Up to twelve samples from the lagoon residuals, peat and clay will be analyzed for SPLP VOCs and metals to assess partitioning, relative mobility potential, and restoration time frames. The SPLP analyses will be used, in part, to provide a basis for the selection of samples and parameters for subsequent column leaching tests (See Section 6.5 of the Phase 2 RI/FS Work Plan) and for the assessment of contaminant fate and transport. In particular, the chemical testing, SPLP and permeability results will be used to select a range of stratigraphic units, contaminant types and contaminant concentrations for column leaching tests. Also, the relative difference between SPLP results for different samples and soil types will provide information that will be used in comparing the relative contributions of dissolved phase constituents from various stratigraphic units.

The rationale for the use of SPLP data is provided in the SAP. Eh and BTU analyses will be performed using ASTM methods. These analyses will be performed to provide information regarding site characterization and remedial alternatives. Data generated through the use of these methods will meet or exceed the established task specific data needs/uses.

Soil samples requiring geotechnical analyses (grain size, porosity, permeability, etc.) will be analyzed using a standard or other established protocols under ASTM. These analyses will be performed to provide information regarding site characterization and remedial alternatives. Data generated through the use of these methods will meet or exceed the established task specific data needs/uses.

Physical and Chemical Analysis of Light Non Aqueous Phase Liquids

LNAPL samples requiring characterization will be analyzed for DRO/GRO, specific gravity, Total Organic Halides (TOX), viscosity, waste disposal parameters, and BTU using the USEPA SW-846 or ASTM protocols. These analyses will be performed to assess the relative concentration and molecular weight distribution of the large number of petroleum hydrocarbon compounds which are individually identified as tentatively identified petroleum hydrocarbons, as well as the feasibility of potential remedial actions. Data generated through the use of these methods will meet or exceed the established tasks specific data needs/uses.

8.0 QUALITY CONTROL CHECKS

The following sections describe the QC checks that are commonly applied to investigations and their definition and purpose. There are two main areas of the data gathering process which may be checked: the field procedures and the laboratory procedures. A summary of the various field and laboratory QC checks applicable to this project and their required frequencies are provided in Tables 4 and 5, respectively. Data from the quality control checks will be used to establish the usability of the data for site characterization purposes, establish the distribution of COPCs through the use of gradients, evaluate temporal changes in COPC distributions and concentrations, evaluate fate and transport and exposure routes of the COPCs, and evaluate potential receptors in order to assess potential risk.

8.1 Field Generated Quality Control Checks

Field generated QC checks are samples sent to the laboratory from the field by either the field sampling team (internal) or by a third party (USEPA, NJDEP). These types of samples serve as checks on both the sampling and measurement systems, and assist in determining the overall data quality with regard to representativeness, accuracy and precision. The number and type of field QC samples submitted varies with the intended data use and the level of contamination (i.e., sample analyte concentrations) expected.

8.1.1 Internal Field Checks

Trip blank

Trip blanks generally pertain to volatile organic samples only. Trip blanks are prepared at the laboratory by filling a sample container with analyte-free water (water samples) or methanol spiked with the appropriate surrogates (soil samples) prior to the sampling event. The trip blanks are then transported to the field and are kept with the investigative samples throughout the sampling event. They are then packaged for shipment with the other samples and sent for analysis. There should be one trip blank included in each sample shipping container for shipments with VOC samples. The samples are used to determine if any cross-contamination between sample containers occurs. At no time after their preparation are the trip blank sample containers opened before they reach the laboratory.

Field Blank

Field blanks (also called decontamination rinseate blanks) are defined as samples which are obtained by running analyte-free water through sample collection equipment (bailer, pump, auger, etc.) after decontamination, and placing it in the appropriate sample containers for analysis. One field blank will be collected each day for each matrix. These samples are used to determine if decontamination procedures are adequate.

Duplicates

Field duplicates (also called replicates or collocates) are individual portions of the same (replicates) or essentially the same (collocated) field sample. Collocates are independent samples collected in close proximity to one another such that they are essentially an equal representation of the parameter(s) of interest at a given point in space and time. Examples of collocated samples include: samples from two air quality analyzers sampling from a common sample manifold, two water samples collected at essentially the same time and place from the same source, and side-by-side soil core samples. Field duplicates for soil samples will be collocated samples. For ground-water, duplicates will consist of two separate samples collected from the same field sampling point by alternately filling sampling containers. Split samples will be replicate samples.

Collocated samples, when collected, processed, and analyzed by the same organization, provide intralaboratory precision information for the entire measurement system including sample acquisition, homogeneity, handling, shipping, storage, preparation and analysis. Collocated samples, when collected, processed and analyzed by different organizations, provide interlaboratory precision information for the entire measurement system.

Replicate samples are samples from the same sampling point that have been divided into two or more portions at some step in the measurement process after sample collection. An example of a field replicate sample would be a soil core sample that has been collected, split, and placed into two or more individual sample containers.

Duplicate samples will be collected at a rate of one per Sample Delivery Group (SDG). Duplicate samples will be used to estimate the overall precision of a data collection activity. Sampling error can be estimated by the comparison of collocated and replicated results from the same sample. If a significant difference in precision between the two subsets is found, it may be attributed to sampling design error.

Blinds

Blind samples can be either internal or external field QC samples. Internal blind samples are samples of known (performance evaluation, reference) or unknown (field sample replicates) concentration sent to the laboratory as routine field samples to test laboratory performance. One blind sample will be collected for each matrix.

Splits

Split samples can be either internal or external field QC samples. Split samples are replicate samples sent to different laboratories and subjected to the same environmental conditions and steps in the measurement process. One split sample will be collected for each matrix. They serve as an oversight function in assessing the analytical portion of the measurement system (particularly interlaboratory precision).

8.1.2 External Field Checks

Blinds

Blind samples can be either internal or external field QC samples. External blind samples are usually samples of known (performance evaluation, reference) concentration sent to the laboratory (usually by a regulatory agency) as routine field samples to test laboratory performance. One performance evaluation sample will be collected for each matrix.

Splits

Split samples can be either internal or external field QC samples. External split samples are replicate samples sent to different laboratories and subjected to the same environmental conditions and steps in the measurement process. They serve as an oversight function in assessing the analytical portion of the measurement system (particularly interlaboratory

precision). External split samples may be generated for regulatory agencies, local resident oversight groups, or other interested/responsible parties. One split sample will be collected for each matrix.

8.2 Laboratory Generated Quality Control Check Samples

Laboratory generated QC check samples are samples generated at the analytical laboratory by the laboratory personnel from the same (internal) or a different (external) laboratory. These types of samples serve as checks on the laboratory sampling and measurement systems and assist in determining the data quality with regard to laboratory accuracy and precision. The number and type of laboratory QC check samples varies with the intended data use and the level of contamination (i.e. sample analyte concentrations) expected.

Laboratory QC check samples may measure either method and/or instrument performance. Method (preparation) performance check samples collectively measure the entire laboratory analytical data generation process, from sample allocating in the laboratory through the analysis and data reduction. Instrument (analysis) check samples measure the laboratory performance from the point where analysis begins, generally excluding any preparation/extraction affects, through the analysis and data reduction.

8.2.1 Internal Laboratory Checks

At a minimum, each laboratory will analyze a method blank, laboratory control sample, duplicate and matrix spike sample for TAL metal analyses and a method blank, matrix spike and matrix spike duplicate for VOC and SVOC analyses. Specific method QC samples for the remaining analyses are outlined in Table 5.

Method Blank

Method blanks (also called preparation blanks) are usually aliquots of analyte free water which are processed through all procedures, materials, reagents, and labware used for sample preparation and analysis. However, a method blank may be an aliquot of a matrix (such as washed sand) in order to more appropriately match the matrix of interest. Method blanks will be

analyzed at the rate specified by the method. Method blanks are used to determine if contaminants are present in the reagents, laboratory preparation, or analysis systems.

Reagent Blank

A reagent blank is prepared in the same manner as a method blank but is not subjected to the preparation procedures (digestion and/or extraction). Reagent blanks are used to determine the purity of the reagents used in the preparation/extraction and to isolate other contamination present in the analysis system. Reagent blanks will be analyzed at the rate specified by the method.

Duplicates

Laboratory duplicate samples fall into two basic categories: samples run through the entire sample allocating, preparation and analysis method (method or matrix duplicates) and samples run through only the analysis method (analysis or instrument duplicates). In either case a "duplicate" is a second, additional aliquot of the same sample generated at either the pre-preparation or post-preparation step of the method and carried from that point on through the rest of the method as a routine sample. Duplicate samples are used to define either method (preparation plus instrument) or instrument precision. For organic methods, two duplicate aliquots of the same sample are prepared and spiked (MS and MSD) in lieu of a normal matrix duplicate. Duplicate samples will be analyzed at the rate specified by the method.

Matrix Spike

Matrix spike and matrix spike duplicate samples are used to determine matrix effects of the sample. Samples collected from the site are fortified ("spiked") with a known quantity and concentration of analyte and carried from sample preparation through analysis. Spike samples will be run at the rate specified by the method.

System Monitoring Compounds (Surrogates)

System monitoring compounds are similar to matrix spikes and generally apply only to organic parameters. System monitoring compounds are compounds which are not expected to occur in

the environment and are added to all samples and are used to measure the effect of the sample matrix on specific compound recoveries. Surrogates are used to help define accuracy.

Internal Standards

Internal standards are similar to analysis spikes and generally apply only to organic parameters. Quantities of known concentration are added to all samples after preparation/extraction. These samples are used to determine the amount of variance in a measurement system due to transport, spectral, and other affects. Since the internal standard is a known quantity of analyte(s) generally not found in the environment, the results of the other analytes may be corrected for measurement system effects based on the percent recovery of the internal standard.

Control Samples

Laboratory control samples fall into two basic categories: samples run through the entire sample allocating, preparation, and analysis method (method or matrix controls) and samples run through only the analysis method (analysis or instrument controls). In either case, control samples are samples of known or certified concentration which are introduced at either the pre-preparation or post-preparation step of the method and carried from that point on through the rest of the method as a routine sample. Control samples are used to define either method (preparation plus instrument) or instrument accuracy. Examples of laboratory control samples are standard reference materials (SRMs), performance evaluation (PE) samples, laboratory control samples (LCSs). Control samples will be analyzed at the rate specified by the method.

Analytical Batch

An analytical batch is a group of field and associated QC samples which are prepared (and preferably analyzed) concurrently using the exact same method, techniques, materials, reagents, labware, etc. Generally, a laboratory analytical batch is defined as twenty or fewer field samples of the same matrix prepared and processed at the same time. All associated QC samples discussed above should be prepared concurrently, and in addition to, the twenty or fewer field samples.

8.2.2 External Laboratory Checks

Round Robin Samples

Round robin samples are samples generated at one laboratory and sent to other laboratories for confirmation analysis. The "true" sample concentration is determined based on the statistical analysis of the various results reported by each laboratory. These samples are usually used to gauge precision. Examples of these types of samples include interlaboratory confirmation samples, proficiency analytical testing samples (PATs), and in some cases PE samples (in order to assign "true" values for the PE sample). When a backup laboratory is selected, round robin samples will be prepared and analyzed. One set of round robin samples will be prepared by LLI for analysis by the backup laboratory for each matrix the backup laboratory will be analyzing. A second set of round robin samples will be prepared by LLI for analysis by OnSite for each matrix OnSite will be analyzing. A third set of round robin samples will be prepared the backup laboratory for analysis by LLI for each matrix LLI will be analyzing

Performance Evaluation Samples

Performance evaluation (PE) samples are samples of known or assumed (based on round robin analyses) known concentration which are submitted to the laboratories by certifying (e.g., Environmental Resource Associates) or contracting agencies (e.g., CLP). PE samples are used to test the laboratory's competence in sample analysis and/or data package documentation and assembly. In terms of data quality, the PE sample is used to measure accuracy. If warranted by inconsistent laboratory performance (i.e., excessive data validation issues or inability to meet the numeric DQOs) and an USEPA request, one performance evaluation sample may be analyzed for each parameter (VOCs, SVOCs, PCBs, TPH, and TAL Metals) in each matrix (soil, waste, and aqueous) by each of the off-site laboratories. One performance evaluation sample may be analyzed for each parameter (VOCs, TPH, and lead) in each matrix (soil and aqueous) by the on-site laboratory.

8.3 Standards Preparation

Calibration standards are either prepared in the laboratory by dissolving or mixing a known amount of nominally pure analyte in the appropriate matrix using volumetric containers or purchased from a certified source. Calibration standards must be prepared from a standard

source which is traceable to a certified primary reference material (National Institute of Standards and Technologies or other certifying agency). All calibration standards must be prepared so that the types and concentration of the reagents used in the standard preparation are equivalent to the types and concentration of the reagents used in preparing the samples to be analyzed. Calibration curves are then generated to quantify the field sample results by comparison of the field sample response against the calibration standard response.

8.4 Reagents Preparation

All reagents used for analysis must be documented to be free of significant analyte concentration (i.e., all analytes to be measured are present below required detection limits) during or prior to the use of the reagents for sample preparation or analysis. Reagent blanks or method blanks (as required by the specific method) and other associated QC samples must be prepared using the same reagent lot(s) used for the actual field sample preparation. All reagent lots used for sample and standard preparation and analysis must be documented so that any resulting contamination problems can be traced to the specific standards and samples which were prepared using the reagent lot(s).

8.5 Calibration Checks

Once the calibration of an analysis system has been established using calibration standards, it is necessary to check the analysis system initially and periodically to verify correct standard preparation and system performance. Important elements to verify before and during the course of sample analysis include the accuracy of the calibration across the range of concentrations to be measured, the sensitivity of the instrument during the specific analysis run, and other transient changes in instrument performance, such as drift and linearity. To accomplish this verification task, analytical protocols require the analysis of calibration QC samples which serve as instrument checks and as triggers for necessary corrective action. The types and frequencies of calibration checks specified in the method will be employed (See Attachment 1). As examples, descriptions of some of the calibration checks that may be used are provided below.

Initial Calibration Check Standard

The initial calibration check standard will be prepared in the concentration range of greatest interest, using an agency supplied standard or an alternate standard source (i.e., a different standard manufacturer) than that used for the calibration standards. The check standard must be prepared utilizing the same reagents and reagent concentration used for both the calibration standards and field samples. The purpose of this standard is to verify the accuracy of the initial calibration before any samples are analyzed.

Continuing Calibration Check Standard

The continuing calibration check standard will be prepared in the same manner as the initial calibration check standard, except that it may be from either the same source, or from an alternate source as the calibration standards. The purpose of the continuing calibration check standard is to provide a periodic check on the accuracy of the calibration curve during sample analysis.

Initial Calibration Blank

An initial calibration blank (ICB) is a reagent blank prepared utilizing the same reagent(s) and reagent concentration used for both the calibration standards and the field samples. The purpose of the ICB is to verify that the sensitivity of the instrument meets the required limit of quantification before any samples are analyzed.

Continuing Calibration Blank

The continuing calibration blank (CCB) is prepared in the same manner as the ICB. The purpose of the CCB is to verify both the lack of baseline drift and the instrument sensitivity during analysis.

Near Detection Limit Standard

This standard is a calibration standard prepared to be at or near the required limit of quantitation (detection limit) for the measurement system (typically at the required detection limit or two times the required detection limit). The purpose of this standard is to provide a gauge of the accuracy of the instrument/instrument calibration at or near the required limit of quantitation.

Linear Range Verification Standard

The linear range verification standard is a calibration standard prepared at a concentration greater than any of the calibration standards. The purpose of this standard is to verify accuracy of the analytical system at analyte concentrations greater than the highest calibration standard. This standard is generally only applicable to analytical systems with wide ranges of linearity (typically three or more orders of magnitude), such as ICP, where calibration across the entire linear range is cumbersome or impractical.

Interference Check Sample

The interference check sample (ICS) is a standard material prepared by spiking (fortifying) a solution of analytes of interest (in the concentration range of interest) with interfering analytes of a much higher concentration. The purpose of this sample is to verify that the analytical system is free from interference's due to the interfering analytes at the concentrations much greater than the concentrations of analytes of interest present in the ICS.

8.6 Control Limits

Control limits are used to determine if acceptable method performance has been achieved. In general, control limits are developed for methods where a standard level of performance has yet to be established and/or set limits of performance have not been validated through multiple analyses and statistical manipulation.

The basis of a control limit is to determine an accepted mean result and the allowable variance around the accepted mean. Typically, the allowable variance is measured in terms of the "level of confidence" in a particular result. Based on a statistical analysis of the results obtained over a period of time, the mean and standard deviation of the measurements can be determined. Once these values are known, a control limit can be established using the mean as the "true" value and some multiple of the standard deviation (confidence level) as the allowable variance. For most control limits, the allowable variance is set at the 95 percent or 99 percent confidence level, meaning there is a 95 or 99 percent chance that the control sample value will fall within the range of the control window, if the method is performed correctly.

Where established limits of acceptability are not available for this project's analyses, a minimum criteria of ± 50 percent will be required for method accuracy. A relative percent difference (RPD) of 20 for aqueous samples and 35 for soil samples will be required for method precision. Completeness will be established based on the precision and accuracy criteria noted above.

If no reference material with published acceptance limits meeting the criteria established above (for analyses without established limits of acceptability) is available for the specified analytical method, statistically valid control limits for the analytical method must be developed by the laboratory prior to analysis of any field samples. All field sample results reported from this analytical method must be concurrently prepared and analyzed with a laboratory generated control sample having a result within \pm three standard deviations (99 percent confidence level) of the mean result established by the laboratory through the use of control limits.

8.7 Database/Electronic Media Quality Control Checks

For data entered into electronic media by laboratories and contractors other than Roux Associates, Inc., all electronic media will be verified through the data validation and authentication (if applicable) programs as described in Section 14.0. Hardcopy data from the laboratories and/or contractors will also be compared against the electronic media generated by these sources at the level and frequency specified in Section 14.0.

For data input into databases, or electronic media generated by Roux Associates, Inc., the quality of the data entry and output will be verified according to the Roux Associates, Inc.' SOP for Project Quality Assurance/Quality Control Procedures included in Appendix E.

9.0 INSTRUMENT/EQUIPMENT TESTING, INSPECTION AND MAINTENANCE REQUIREMENTS

The preventative maintenance procedures described below are designed to prevent injury and loss of time and data due to faulty equipment/instrumentation. The purpose of preventative maintenance is to address potential problems before they occur and to help assure that equipment/measurement systems operate adequately when used for routine project activities.

9.1 Field Equipment/Instruments

The planned field instruments for this project include: photoionization detector, flame ionization detector, water-level meter, pH meter, conductivity meter, DO meter, and electronic thermometer. Specific preventative maintenance procedures to be followed for these and other field equipment are those recommended by the manufacturer and described in the applicable Roux Associates, Inc. SOPs (see SAP Attachment 1).

Table 7 summarizes the relevant preventive maintenance procedures for specific pieces of field equipment to be used for sampling, monitoring, and documentation for this project.

Field instruments will be checked and calibrated in the office before they are shipped or carried to the field at the start of the project. These instruments will be checked and calibrated in the field on a daily basis before and after use. Calibration checks will be performed and will be documented in the field logbook.

9.2 Laboratory Instruments

As part of their QA/QC Program, the laboratory will conduct a routine preventative maintenance program to minimize the occurrence of instrument failure and other system malfunctions.

These procedures will be documented in the laboratory QA Plan (Attachment 1). Roux Associates, Inc. will perform oversight of the laboratory maintenance program through the audit functions described in Section 13.0.

9.3 Documentation

Appropriate documentation of all equipment/instrument maintenance shall be maintained by the field and laboratory personnel and shall include what was done, date, time (if appropriate), next scheduled maintenance, equipment status, anomalies, and person performing maintenance. This documentation shall be entered into field logbooks, or into specific maintenance log forms for off-site maintenance activities.

10.0 INSTRUMENT CALIBRATION PROCEDURES AND FREQUENCY

This section describes procedures for maintaining the accuracy of all measurements and measuring equipment which are used for conducting field tests and laboratory analyses. All equipment must be calibrated prior to each use and on a periodic basis.

10.1 Field Instruments/Equipment

Field instruments and equipment used to gather, generate, or measure environmental data will be calibrated with sufficient frequency and in such a manner that accuracy and reproducibility of results are consistent with the manufacturer's specifications. The calibration and use of field instruments are described in the SAP.

Equipment to be used during field sampling will be examined to certify that it is in operating condition. This includes checking the manufacturer's operating manual to ensure that all maintenance requirements are being observed. Backup instrumentation will be sent into the field where possible. Two thermometers will be sent to sampling locations where measurement of temperature is required, including those locations where a specific conductance probe/thermometer is required. Preventive maintenance will be conducted for equipment and instruments to ensure the accuracy of measurement systems, and to verify the availability of spare parts and backup systems (see Section 9.0).

Calibration of field instruments is governed by the specific SOP for the applicable field analysis method, and such procedures take precedence over the following general discussion.

Calibration of field instruments will be performed at the intervals specified by the manufacturer; the New Jersey approved SOPs for pH, DO, specific conductance, and temperature; and NJ lab certification specifications - or more frequently as conditions dictate. Field instrumentation may include the following: PID, FID, pH meter, water level meter, conductivity meter, dissolved oxygen meter, and electronic thermometer for water analyses. In the event that an internally calibrated field instrument fails to meet calibration/checkout procedures, it will be removed from service until the problem is resolved. Calibration documentation will be maintained in a separate

bound log book. The equipment type, model number and serial number; the type of calibration standard; the time and date of calibration; the instrument span settings, the instrument reading during calibration, and the name of the person performing the calibration will be recorded in the log book.

10.2 Laboratory Instruments

Calibration procedures and frequencies are specified in the method selected for analysis. Records of calibration, repairs, or replacement will be filed and maintained by the designated laboratory personnel performing QC activities. These records will be filed at the location where the work is performed and will be subject to QA audits. For all instruments, the laboratory will retain a factory-trained repair staff with in-house spare parts or will maintain service contracts with vendors.

The records of laboratory calibration will be kept as follows:

- if possible, each instrument will have a record of calibration permanently affixed with an assigned record number;
- a label will be affixed to each instrument showing description, manufacturer, model numbers, date of last calibration, by whom calibrated (signature), and due date of next calibration. Reports and compensation or correction figures will be maintained with the instrument;
- a written stepwise calibration procedure will be available for each piece of test and measurement equipment; and
- any instrument that is not calibrated with the manufacturer's original specification will display a warning tag to alert the analyst that the device carries only a "Limited Calibration."

More detailed information on the calibration of laboratory equipment is presented in Section 8.0 of this QAPP and in the laboratory QA plan included as Attachment 1.

10.3 Standards/Calibration Solutions Preparation

The standards/calibration solutions preparation will be performed in accordance with method requirements and, if applicable, and using good laboratory practice (GLP) in all cases. More specific information on standards and reagent preparation is provided in Sections 8.3 and 8.4 of this QAPP.

11.0 ASSESSMENT AND RESPONSE ACTIONS

The types, frequencies and content of the various audits and audit functions to be applied to this project are provided in this section. Audits for the work generally consist of four types: management audits, data quality audits, technical systems audits and performance audits. These audits may be internal (performed by the same agency/organization generating the information) or external (performed by an outside agency/organization). The purpose of these audits is to establish and verify that the sampling and analysis activities are performed in accordance with the QAPP.

Project audits are intended to provide information regarding:

- on-going assessment of the data quality;
- identification of areas with a need for improvement;
- verification of QA program implementation;
- assessment of applied resources to complete the assigned tasks; and
- address changes and/or variances to procedures necessitated by the actual field or laboratory conditions.

Confirmation of the specific and overall QA/QC objectives for this project will be obtained through the use of management, performance and systems audits conducted by Roux Associates, Inc., the BROS Technical Committee or a third party retained by the BROS Technical Committee. The specific content and frequency of audits anticipated for this project are delineated below.

11.1 Management Audits

Management audits will be performed by Roux Associates, Inc. the BROS Technical Committee or a third party to determine whether the management functions and responsibilities related to environmental measurements are performed in accordance with Roux Associates, Inc.' QA

procedures. Management audits will include a review of the QAPP implementation for this project in order to evaluate:

- the level of management support;
- the field and analytical tracking systems;
- the procedures for developing the project DQOs;
- the procedures for developing, approving and reviewing the QAPP;
- the procedures for developing and approving SOPs; and
- the procedures and schedules for conducting audits.

Management audits are an on-going function of the project's QA/QC procedures. Project-specific management audits for this project are the responsibility of the Project Manager and will be conducted on a monthly basis for each management function. The Project Manager will review the management program and the other audit functions on a routine basis.

11.2 Data Quality Audits

Data quality audits will be performed by Roux Associates, Inc. the BROS Technical Committee or a third party to determine whether data derived as part of the work are of known quality. Data quality audits will be supported by the data validation effort to determine whether or not sufficient information exists with the data set to support an assessment of data quality. Through the use of data validation and authentication (if applicable), information provided by Roux Associates, Inc. and its contractors will be used to audit and evaluate:

- if a data set, or all the data sets of a particular project, met the DQOs;
- if the contractor collecting or reducing the data performed their own data quality assessment; and
- if the contractor identified deficiencies (if they existed) and corrected the cause(s), both technical and managerial.

For data generated by laboratories and contractors other than Roux Associates, Inc., all data will be verified through the data validation and authentication (if applicable) as described in Section 8.0. Hardcopy data from the laboratories and/or contractors will be checked for completeness and accuracy of data reduction at the level and frequency specified in this section. For data validation performed by Roux Associates, Inc.'s subcontractors, key data may be subject to additional Roux Associates, Inc. validation based on its importance in decision making for the project. The Data Validator's qualifications are provided in Appendix C.

For data generated by Roux Associates, Inc., the quality of the data entry and reduction will be verified according to the Roux Associates, Inc. *Evaluation and Validation of Data SOP* in Appendix F and the Roux Associates, Inc.'s QA/QC procedures SOP included in Appendix E.

All data quality functions will be subject to Roux Associates, Inc. oversight to assure the accuracy and completeness of the data reduction and validation efforts. Data quality audits are the responsibility of the PQAC and two data quality audits will be implemented, one during the first half of field activities and one after field activities have been completed. At a minimum, the PQAC will review the data validation effort, perform spot checks on the quality of the data validation effort, and document his/her findings.

11.3 Technical Systems Audits

Technical systems audits will be performed to determine if the field and laboratory sampling and analytical systems specified in the SAP and QAPP are sufficient to generate data which will meet the stated DQOs. These audits will include the on-site examination of field and laboratory activities for quality and conformance to the SAP and QAPP. Both internal (performed by the same agency/organization generating the information) and external (performed by an outside agency/organization) audits will be performed for both the field and laboratory systems.

11.3.1 Field Audits - Internal

The internal field audits will include examination and review of field sampling records, field instrument operating records, sample collection, handling, packaging and shipping procedures, maintenance of QA procedures, chain of custody, etc. to determine conformity to the SAP and

QAPP. Internal audits of field activities (sampling and measurements) will be conducted by the Roux Associates, Inc. PQAC and/or Project Manager. Should any deficiencies be discovered during the course of the audit, the PQAC will have the authority to take any necessary action, including implementing a "stop work" order, to correct the deficiency.

Two internal field audits will occur at the onset of the project to verify that all established procedures are followed. Follow-up audits to correct deficiencies, and to verify that QA procedures are maintained throughout the investigation, will be conducted on an as needed basis. The specific contents of these audits will be based on Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) guidelines.

11.3.2 Field Audits - External

At this time it is not anticipated that external audits of the field activities will be necessary. However, if the internal audits determine that deficiencies exist which require an outside organization or agent to resolve the problem(s), Roux Associates, Inc. will employ the services of an outside subcontractor to audit the field activities and make/suggest corrections to the problem.

11.3.3 Laboratory Audits - Internal

The internal laboratory system audits will be performed by the Laboratory QA Officer on an annual basis and will include examination of laboratory documentation on sample receiving, sample log-in, sample storage, chain of custody procedure, sample preparation and analysis, instrument operating records, etc. as described in the laboratory QA Plan (if applicable) or according to the guidelines set forth in the CLP Bid Package documentation regarding laboratory QA requirements.

11.3.4 Laboratory Audits - External

Should any laboratory be selected for this project which has not been audited by the ASP/CLP, or an equivalent audit (state or other federal agency), in the last 12 months, Roux Associates, Inc. the BROS Technical Committee or a third party will perform a laboratory audit using the guidelines set forth in the ASP/CLP Bid Package documentation prior to that laboratory

performing any field sample analyses. At a minimum, the laboratories selected for this project will be audited on an annual basis. The frequency and scope of the audits will be based on the following:

- the scope of work the laboratory will be conducting;
- the results of data validation activities for the project;
- results of audits conducted by others within 12 months of the proposed audit; and
- results of the data validation process.

The results of the audits and the associated recommendations for corrective action will be submitted to the USEPA in letter format within 60 days of completion of the audit. If concerns are identified, a follow-up audit may be conducted or the frequency of the audits may be increased.

11.4 Performance Evaluation Audits

The internal performance audits of the laboratory(ies) will be conducted by the Laboratory QA Officer. The performance audits will be conducted on a quarterly basis. Blind QC samples will be prepared and submitted along with project samples to the laboratory for analysis throughout the project. The Laboratory QA Officer will evaluate the analytical results of these blind performance samples to ensure the laboratories maintain good performance. In addition, performance evaluation samples will be analyzed by both fixed-base laboratories and the on-site laboratory at the beginning of the project and then annually thereafter. The performance evaluation samples will be analyzed for parameters being analyzed by the specific laboratory including: TPH, VOCs, SVOCs, TAL Metals, PCBs and lead.

Internal performance evaluation audits of the field measurements performed by Roux Associates, Inc. personnel may be utilized if suitable reference solutions are available for the specific project activities. These types of checks could include analysis of "blind" calibration span gases for PID measurements, or analysis of USEPA Environmental Monitoring Systems Laboratory aqueous check samples for pH and specific conductance. Additional performance audits will be

conducted as required to maintain New Jersey certification for pH, DO, temperature and specific conductance.

For laboratory checks, tolerance limits for the performance evaluation samples will be based on the accepted values supplied with the check sample/standard. For the field checks, the tolerance limits will also be based on the accepted values supplied with the check sample/standard, but may be modified as necessary to take into account the less quantitative (screening) nature of the field analytical measurements.

12.0 CORRECTIVE ACTIONS

Corrective action generally addresses the need to bring data generating systems back into conformance after some trigger or other criteria have shown the system to be out of conformance. The following paragraphs describe the mechanics of how corrective action will be managed and implemented during the course of this project.

Corrective actions may be required for two classes of problems: analytical and equipment functional problems, and noncompliance problems. Analytical and equipment functional problems may occur during sampling and sample handling, sample preparation, laboratory instrumental analysis, and data review. The need for laboratory analysis corrective actions is based on predetermined limits for acceptability (Section 3.0). By conducting system and performance audits, the Laboratory QA Officer will determine if the overall data generating systems are acceptable (Sections 14.0 and 15.0).

For noncompliance problems, a formal corrective action program will be determined and implemented at the time the problem is identified. The person who identifies the problem is responsible for notifying the PQAC and/or Project Manager. If the problem is analytical in nature, information on these problems will be promptly communicated to the Laboratory QA Officer and method specific corrective actions will be implemented.

12.1 Field Corrective Action

Corrective actions will be implemented by field personnel and documented in the field record book. No staff member will initiate corrective action without notification through the proper channels. If corrective actions are insufficient, a stop-work order may be issued by the Project Manager.

Technical staff and project personnel will be responsible for reporting all suspected technical or QA nonconformance, or suspected deficiencies of any activity (or issued document) by reporting the situation to the Project Manager or designee. The Project Manager will be responsible for assessing the suspected problems in consultation with the PQAC and for making decisions based

on the potential for the situation to impact the quality of the data. If it is determined that the situation warrants a reportable nonconformance and/or requires corrective action, then a nonconformance report will be initiated by the field personnel and submitted to the Project Manager for review.

The Project Manager will be responsible for ensuring that corrective action for nonconformances are initiated by:

- evaluating all reported nonconformances;
- controlling additional work on nonconforming items;
- determining disposition or action to be taken;
- maintaining a log of nonconformances;
- reviewing nonconformance reports and corrective actions taken; and
- ensuring nonconformance reports are included in the site documentation project files.

If appropriate, the Project Manager will ensure that no additional work which is dependent on the nonconforming activity be performed until the corrective actions are completed.

Corrective action for field measurements may include the following:

- repeat the measurement to check the error;
- check for all proper adjustments for ambient conditions such as temperature;
- check the batteries;
- recalibration;
- check the calibration;
- replace the instrument or measurement devices; and
- stop work (if necessary).

The Project Manager or his designee is ultimately responsible for all site activities. In this role, the Project Manager at times is required to adjust the site programs to accommodate the site

program specific needs. The change in the program will be documented on the Field Change Request form (Appendix G) that will be signed by the initiators and the Project Manager or designee. The Field Change Request shall be attached to the file copy of the affected document. The Project Manager and the PQAC must approve the change in writing or verbally prior to the field implementation, if feasible. The Project Coordinator will be notified if adjustments to the site programs are required and fully executed copies of the of the resulting Field Change Request forms will be provided to the Project Coordinator. If unacceptable, the action taken during the period of deviation will be evaluated in order to determine the significance of any departure from established program practices and appropriate action will be taken by the Project Manager to document the significance of the problem.

The Project Manager is responsible for the controlling, tracking, and implementation of the identified changes. Reports on all changes will be distributed to all affected parties.

12.2 Laboratory Corrective Action

Corrective action is required whenever an out-of-control event or potential out-of-control event is noted. The corrective action taken will be somewhat dependent on the analysis and the event. These actions are to be implemented in accordance with the Laboratory QA Plan in Attachment 1 or as the analysis method specifies.

13.0 REPORTS TO MANAGEMENT

Quality assurance reports serve the purpose of identifying, tracking and summarizing any field and laboratory activities which occur during the project. These reports provide a permanent record which addresses the adequacy of the QAPP, problems or deficiencies noted during audits, and resolution of the identified areas of concern. The following sections provide a summary of the report contents and frequency requirements for the writing and submission of QA reports.

13.1 Specific Quality Assurance Reports

In addition to the audit reports submitted to the Project Manager in accordance with Section 11.0, a QA progress report will be submitted periodically to the Project Manager by the PQAC which addresses the identification or resolution of all QA issues occurring over that time period. If a project lasts less than two months, only a final QA report will be submitted. The final QA report will be incorporated into the final project report and will contain QA progress report sections that summarize data quality information collected during the project.

Each periodic or final QA report will include the following types of information: purpose and scope of report, time frame covered, project status (overall and by task if applicable), results of any data quality or other audits conducted during the time period, problem identification/updates/resolution, QAPP changes, project-related training activities, visits by third party organizations, sources of additional information, and who receives the reports.

13.2 Quality Assurance Report Management

Quality Assurance Reports to management will be submitted on a monthly basis. The quality assurance reports will include the following:

- description and results of audits performed during the past month;
- recommendations for correcting deficiencies, if applicable; and
- a summary of the status of previous corrective actions take, if applicable.

The Project Manager will be responsible for assuring that the frequency and content of the report(s) are met. Applicable sections of the report will be sent to the PQAC and the Health and Safety Manager for approval/disapproval. Any deficiencies found in the QA reports will be brought to the attention of the Corporate Quality Assurance Officer and will require correction within 14 days for periodic reports, or within one month for final reports.

The submission of QA reports will be included in the overall project management schedule as critical path points to assist in meeting the QA objectives for this project.

14.0 DATA REDUCTION, VALIDATION AND REPORTING

Applicable methods/procedures will be required for the reduction, validation and reporting of data generated during all phases of this project. Both the field and laboratory data will be subjected to a level of data validation commensurate with the required data quality level. As required by the *USEPA Region II Quality Assurance Manual*, all laboratory data generated during the course of the project will be validated using either *USEPA Region II CLP Organics Data Review and Preliminary Review (SOP No. HW-6, Revision 11)*, or the *Evaluation of Metals Data for the Contract Laboratory Program (SOP No. HW-2, Revision #11)* or the same guidelines modified for non-CLP analyses.

These documents detail the review of data for technical integrity, and the review and qualification process for the non-CLP analysis data is consistent with the process for CLP analysis data. The data qualifications that will be determined from the review of the USEPA SW-846 analyses will reflect the analytical limitations of the data based upon the quality control requirements of the specified methods, with consideration for the definitive performance requirements of the project. The validation and qualification of data derived from non-CLP methods will also be conducted in accordance with the applicable portions of the following USEPA Region II data validation SOP documents:

- *Low Concentration Water Data Validation Standard Operating Procedure (Revision 1) (USEPA 1992c);*
- *SW-846 Method 8270B Data Validation Standard Operating Procedure (Revision 0) (USEPA 1995a);*
- *SW-846 Method 8080A/8000A Data Validation Standard Operating Procedure (Revision 0) (USEPA 1995b); and*
- *SW-846 Method 8250A Data Validation Standard Operating Procedure (Revision 1.0) (USEPA 1995c).*

These data validation documents incorporate method-specific quality control criteria with general quality control criteria also found in the CLP validation SOPs.

The quality control criteria variations between the non-CLP and CLP analyses include those variations that are method-defined. These variations include but are not limited to:

- processing procedures;
- instrument tuning procedures; and
- calibration standard concentrations and associated responses

The quality control criteria variations between the non-CLP and CLP analyses also include those variations which are laboratory-specific and determined on a statistical basis. These variations include but are not limited to:

- surrogate standard recovery acceptance ranges;
- matrix spike/duplicate acceptance ranges; and
- method detection limits.

The level of complete transcription checks (raw data to reporting for calculation checks) shall nominally be 10 percent, but this percentage may be increased or decreased depending on the nature and significance of the individual results.

14.1 Data Reduction

Data reduction involves the generation, interpretation and calculation of results from the field and laboratory analyses performed as part of the data gathering effort. In order to make the appropriate decisions, it is necessary to verify that the reported values are correct, both in the way they have been generated (instrument calibration, etc.) and the way they are calculated and reported. Due to the different quantities of documentation and the different quality levels of data generated in the field and the laboratory, somewhat different levels of effort are required for reduction verification for these different data sources. All data will be entered into Microsoft

Access®, an electronic database, in a format that will contain all the fields required by the USEPA's Hazsite Database Format.

Data tables produced will include the following information:

- field sample I.D.;
- laboratory sample I.D.;
- sample matrix;
- sample date;
- sample coordinates;
- sample depth;
- analyte concentrations;
- minimum detection limits; and
- data qualification flags.

14.1.1 Field Data Reduction

Raw data from field measurements and sample collection activities will be appropriately recorded in the field logbook. If the data are to be used in the project reports, they will be documented in the report. All measurement data recorded in field logbooks or field forms will be reviewed by the Project Manager for completeness and clarity. Any discrepancies noted will be resolved by the Project Manager. All calculation equations shall also be verified by the Project Manager and individual calculations will be verified at a minimum frequency of 30 percent by the PQAC. Any field information entered into data systems will be subject to the Roux Associates, Inc. QA/QC procedures (Appendix F).

14.1.2 Laboratory Data Reduction

The off-site laboratory will perform in-house analytical data reduction and validation under the direction of the Laboratory QA Officer. The Laboratory QA Officer is responsible for assessing data quality and advising of any data which were rated "preliminary" or "unacceptable" or other notations which would caution the data user of possible unreliability. Data reduction, validation, and reporting by the laboratory will be conducted as follows:

- raw data produced by the analyst is turned over to the respective area supervisor;
- the area supervisor reviews the data for attainment of QC criteria as outlined in the USEPA Region II data validation guidelines and/or established USEPA methods and for overall reasonableness;
- upon acceptance of the raw data by the area supervisor, a computerized report is generated and sent to the Laboratory's QA Officer;
- the Laboratory's QA Officer will complete a thorough audit of reports at a frequency of one in ten, and an audit of every report for consistency;
- the Laboratory's QA Officer and area supervisors will decide whether any sample re-analysis is required; and
- upon acceptance of the preliminary reports by the Laboratory's QA Officer, final reports will be generated and signed by the Laboratory's Project Manager. The laboratory package shall be presented in the same order in which the samples were analyzed.

Data reduction reporting procedures will be those specified in the CLP SOW for inorganic and organic analyses. To the extent practical, laboratories will prepare and retain full analytical and QC documentation similar to that required by the Contact Laboratory Program (See Section 7.1 for additional detail on the level of documentation that will be provided by the laboratories).

The laboratory will report the data in chronological order along with all pertinent QC data. Laboratories will provide the following information to the prime contractor in each analytical data package submitted.

1. Cover sheets listing the samples included in the report and narrative comments describing problems encountered in analysis.
2. Tabulated results of inorganic and organic compounds identified and quantified.

3. Analytical results for QC samples, spikes, sample duplicates, initial and a continuing calibration verification standards and blanks, standard procedural (method) blanks, laboratory control samples, and Inductively Coupled Plasma (ICP) interference check samples.
4. Raw data system printouts (or legible photocopies) identifying: date of analyses, analyst, parameter(s) determined, calibration curve, calibration verifications, method blanks, sample and any dilution's, sample duplicates, spikes and control samples.
5. Sample preparation/extraction/analysis logs including weights, volumes and dilution's.

14.2 Field Data Validation

Field data assessment will be accomplished by the efforts of the PQAC and/or Project Manager. The data assessment by the Project Manager or his designee will be based on the criteria that the sample was properly collected and handled according to the SAP and Section 5.0.

14.3 Laboratory Data Validation

Validation of laboratory generated data will be performed by a Roux Associates, Inc.'s sub-contractor. The qualifications of this firm are provided as Appendix C. The Contractor data reviewer will conduct a systematic review of the data for compliance with the established QC criteria based on the spike, duplicate and blank results provided by the laboratory. A thorough review of blank results will be conducted as a component of the data evaluation process (Section 5.0). An evaluation of data accuracy, precision, representativeness and completeness, based on criteria in Section 3.0, will be performed and presented in the summary report.

The data reviewer will identify any out-of-control data points and data omissions and interact with the laboratory to correct data deficiencies. Decisions to repeat sample collection and analyses may be made by the Project Manager based on the extent of the deficiencies and their importance in the overall context of the project.

Data validation for laboratory data will be performed in accordance with the *USEPA Region II CLP Organics Data Review and Preliminary Review (Revision 11)*, May, 1996 (USEPA, 1996b)

and Evaluation of Metals Data for the Contract Laboratory Program (Revision 11), January, 1992 (USEPA, 1992a). As non-CLP analysis will be used, these guidelines will be modified according to the applicable method and required QA/QC. It is anticipated that all laboratory data will be validated (i.e., complete transcription checks, calculation checks, etc.).

These documents involve review of data for technical integrity, and much of the review process and subsequent qualifications of the data are consistent with the CLP and the non-CLP methods. The data qualifications that will be determined from the review of the USEPA SW-846 analyses will reflect the analytical limitations of the data based upon the quality control requirements of the specified methods, with consideration for the definitive performance requirements of the project. These requirement variations may include holding times, sample preservation, instrument performance, and accuracy and precision limits.

Method Development Studies to Increase Data Usability

Significant matrix interference effects will be encountered for some areas of the site. Based on the USEPA's previous work at the site, qualified data and data with elevated detection limits are expected in these areas. To minimize the anticipated matrix interference effects, a method development activity was implemented and the resulting changes are included in this QAPP. As part of this activity, the LLI used media from the BROS site to evaluate potential method modifications and cleanup methods for VOC, SVOC and PCB analyses as a means of addressing matrix interferences before site characterization samples are received. The completion of method development activities ahead of the site characterization provided the LLI with the ability to perform various trial modifications without exceeding the holding times for characterization samples. Moreover, the early development and approval of revised methods will reduce the likelihood of having to repeat sampling and field activities due to critical RI data being qualified or rejected.

The Analytical Method Development activity involved the collection of samples of the following complex matrices from the BROS site:

- LNAPL from existing site monitoring wells MW-13A and P-5;

- peat from proposed boring locations PB-4 and P-24;
- lagoon residuals/mud wave soils from boring locations L-9A and L-10A;
- sediments from the expected area of the *de manifestis* and intermediate zones at LTC-8, LTC-10, LTC-25 and LTC-28; and
- ground water from monitoring wells S-2A and MW-1A located in the vicinity of the lagoon.

Sample locations were based on the review of historical site data and field observations at the time of sample collection. Sample collection was in accordance the procedures set forth in the Sampling and Analysis Plan for the BROS site. A drill rig was required to facilitate the collection of subsurface soil and peat samples. The sediment samples analyzed for VOCs were collected using three different techniques to evaluate differences in DQOs. Two sets of samples were collected using the methods describe in Section 7.6.2 of the SAP. The first set of samples was shipped to the laboratory unpreserved and the second set of samples was preserved with methylene chloride. A third set of samples was collected using the EnCore® sampling device and shipped to the laboratory without preservation.

After the samples were collected, they were submitted to LLI for analysis for VOCs, SVOCs, and PCBs. The laboratory then evaluated the analytical data quality and determined if sample extract cleanup for SVOCs and PCBs or other method modifications will improve data usability or more effectively achieve DQOs. If the initial analysis of the SVOC and PCB samples indicated that the quantitation limits do not meet the required DQOs, sample extract cleanups were conducted on each matrix analyzed for SVOCs and PCBs to evaluate the effectiveness of the cleanup procedures. The analysis of cleaner extracts required less dilutions and resulted in lower quantitation limits. Cleanup methods are not available for VOCs using USEPA SW-846 or CLP methodologies. Sample extract cleanup methods included:

- gel permeation chromatography for SVOCs;

- florisil cleanup for PCBs;
- sulfur cleanup for PCBs; and
- sulfuric acid cleanup for PCBs.

Based on the results of the analytical method development study, Technical Memorandum Number 2, which detailed the proposed sample extract cleanup methods and method modifications, was prepared and submitted to the USEPA on April 16, 1999. The findings of the method development activities are included in this QAPP at the appropriate locations.

Additional method development activities that were conducted included an evaluation of the amount of preservative (hydrochloric acid) required to reduce the pH of ground-water samples, to be analyzed for VOCs, to less than two standard units. This task was accomplished by collecting a duplicate ground water sample for VOCs at site monitoring wells MW-13A and S-11A. After the duplicate samples were collected, the pH of the samples were measured using a pH test strip. In all samples the pH was less than two standard units and the laboratory was notified that the amount of preservative provided is adequate.

Evaluation of Data Usability

Data that is qualified due to matrix interference or the presence of laboratory contaminants will be used in the risk assessments and the FS to the maximum extent possible. Data that is qualified as estimated will be used unless other, more reliable data is available for that exposure pathway. Data that is rejected will not be used in any risk assessment but may be used in a limited manner to assist in determining where and how to resample. The usability of qualified data and data with elevated detection limits will be evaluated in accordance with *Guidance for Data Usability in Risk Assessment - Part A* (USEPA, 1992b), *Guidelines for Ecological Risk Assessment* (USEPA, 1998c) and *Risk Assessment Guidance for Superfund Volume I Human Health Evaluation Manual - Part D* (USEPA, 1998b). The data usability evaluations outlined in Exhibit 3-3 of RAGS Part D (USEPA, 1998b) will be applied for the human health risk assessment.

In the event that potential matrix interference or laboratory contaminant concerns are identified, the laboratory will evaluate that data and prepare a report providing their interpretation of the

accuracy of the data. (Compounds considered common laboratory contaminants include acetone, methylene chloride, and 2-butanone and the various phthalates.) The report will be prepared by senior technical managers at the laboratory and will include the technical basis for any conclusions. Based on the evaluation of laboratory data quality by senior laboratory managers (proactive assessment) or on inquiries by the data validator (retrospective assessment), if the laboratory reports that the detection of an analyte is a laboratory artifact, that result will not be used in the risk assessment and the results for nearby samples, samples within the same sample delivery group and samples collected as part of previous investigations will also be reevaluated. If elevated detection limits for a COPC are attributed to matrix interference based on the evaluation of laboratory data quality by senior laboratory managers (proactive assessment) or on inquiries by the data validator (retrospective assessment) and it is the opinion of the laboratory that the COPC is not present in the sample, the result will be used in the risk assessment.

Furthermore, the usability of data with elevated detection limits will be further evaluated based on an assessment of the location, dimensions, physical condition and varying concentrations of each COPC and the extent of COPC movement through each of the effected media. For each area of concern (AOC) or hot spot with elevated detection limits identified in this report, the data will be evaluated in the following manner:

1. If the detection limits for a COPC within an area of concern are greater than the PRG and the compound was not detected in any samples collected from the site, that COPC will not be included in the risk assessment of that area. This process is designed to significantly reduce the number of COPCs included in the risk assessment and will subsequently minimize the resources required to prepare the risk assessment and reduce potential false positive decisions errors.
2. If the COPC was detected in other areas of the site, but not in the AOC, and the sample quantitation limits (SQLs) for the AOC are less than 5 times the PRG, that compound will not be evaluated in the risk assessment for that AOC. This process will minimize the resources required to prepare the risk assessment for that area and reduce potential false positive decisions errors.

3. If the COPC was detected at concentrations exceeding the PRG in less than 5% of the samples collected from within an AOC and the SQL was below the PRG for most of the samples, and the detection limit for the remaining samples is less than 5 times the PRG; the COPC will not be used in the risk assessment for the AOC. In this instance the site data suggest that a minimal risk is present, as such, this process will minimize the resources required to prepare the risk assessment for that area and reduce potential false positive decisions errors.
4. If the COPC is detected at concentrations exceeding the PRG in less than 5% of samples collected from an AOC and the detection limits for the remaining samples are greater than 5 times the PRG, the COPC will be included in the risk assessment. In this instance the site data suggest that a significant risk could be present under some exposure scenarios, as such, the COPC will be included in the risk assessment to minimize potential false negative decision errors.
5. If the COPC was detected at concentrations exceeding the PRGs in more than 5% of the samples from an AOC it is likely a significant risk could be present under some exposure scenarios, as such, the COPC will be included in the risk assessment for that area.

14.4 Data Reporting

All data generated for the site will be computerized in a database format, using Microsoft Access®, to facilitate data review and evaluation. The computerized data set will include the data flags provided in accordance with the data validation guidelines as well as additional comments of the data reviewer. The data flags will include such items as: 1) estimated concentration due to poor spike recovery, 2) concentration of chemical also found in laboratory blank, and 3) result is rejected. Selected data reviewer comments will also become part of the database in order to indicate whether the data are usable as a quantitative concentration, usable with caution as an estimated concentration, or unusable due to out-of-control QC results.

The site data set(s) will be available for controlled access by the Project Manager, and authorized personnel. The complete data set(s) will be incorporated into the report.

15.0 SPECIFIC AND ROUTINE PROCEDURES TO ASSESS DATA QUALITY OBJECTIVES

The specific methods and equations used to assess the quality of the data with regard to precision, accuracy and completeness are provided in the section. Previous sections in the QAPP have defined the terms of the PARCC parameters, described the methods of data reduction and validation, and described the types and frequencies of the various audit activities (see Sections 3.0, 8.0 and 10.0).

The procedures used to assess the DQOs as outlined in this QAPP were developed to generate data which meets the specific needs of the project. Through the use of a systematic method of data assessment, data of known quality will be produced and applied to the project needs based on the actual data quality.

By subjecting the data to standard calculations and validation guidelines, the usability of the data are enhanced when comparison against past, present or future data is necessary. For the data to be usable for establishing the concentration gradients of compounds of potential concern (COPCs) in select media, evaluating the fate and transport of COPCs, and evaluating exposure routes and potential risks, a high level of data usability based on PARCC parameters is required. Actual use of any data for specific project purposes will be determined by the Project Manager in consultation with the Project Coordinator and USEPA Remedial Project Manager and in coordination with the PQAC, based on the required data quality needs for a particular data set (i.e., matrix type, concentration level, intended data use, quantification accuracy and precision needs, etc.).

15.1 Specific Assessment Parameters

The following sections list the parameters which will be assessed and the calculations applicable to the specific measurement. The acceptable limits for the individual parameters (for both field and laboratory analyses) are discussed in Sections 3.0 and 8.0.

Accuracy:

Accuracy of laboratory results will be assessed using the analytical results of method blanks, reagent blanks, matrix spikes, field blanks, bottle blanks, near detection limit and linear range standards, etc. The percent recovery (%R) of analysis and matrix spike samples will be calculated using the following equation:

$$\% R = \frac{A - B}{C} \times 100$$

Where: A = The analyte concentration determined experimentally in the spiked sample;

B = The analyte concentration determined by a separate analysis of the unspiked sample; and

C = The amount of analyte added in the spike.

Precision:

Precision will be assessed by calculating the relative percent difference (RPD) between the field and/or laboratory duplicate samples (e.g. field duplicates and/or splits, laboratory matrix spike/matrix spike duplicate [MS/MSD] for organic analysis, and laboratory duplicate analyses for inorganic analysis). The RPD will be calculated for each pair of duplicates using the following equation:

$$RPD = \frac{S - D}{(S + D) / 2} \times 100$$

Where: S = First sample value (original or MS value)

D = Second sample value (duplicate or MSD value)

Completeness:

Completeness measures of the amount of valid data obtained from a measurement system compared to the amount of data expected to be obtained under normal conditions. Following

completion of the analytical testing, the percent completeness will be calculated by the following equation:

$$\text{Completeness} = \frac{\text{Valid Data Obtained}}{\text{Total Data Planned}} \times 100$$

Due to the matrix complexities that have been encountered in the past and are expected to be encountered during the Phase 2 RI/FS, data that has elevated detection limits and/or out of range surrogate rates will be considered complete if the laboratories followed the proper procedures, samples were reanalyzed as appropriate and data quality issues can be attributed to matrix interference.

Representativeness:

Representativeness expresses the degree to which data accurately and precisely represent a characteristic of a population, and parameter variations at a sampling point, a process condition, or an environmental condition. Representativeness is a qualitative parameter which is dependent upon the proper design of the sampling program and proper laboratory protocol. The sampling network for this project was designed to provide data representative of site conditions. During development of the sampling network, consideration was given to past waste disposal practices, existing analytical data, and physical setting and processes.

Representativeness of the data will be assessed by the Project Manager and the PQAC through review and comparison of the applicable data (field and laboratory duplicates, splits, spikes, PE samples, etc.) and by verifying that the design set forth in the Work Plan was followed for all data generated during the project activities.

Comparability:

Comparability expresses the confidence with which one data set can be compared with another. The extent to which existing and planned analytical data will be comparable depends in part on the similarity of sampling and analytical methods. The procedures used to obtain the planned analytical data, as documented in the QAPP, are expected to provide comparable data for these

project activities (i.e., intra-project comparison). These new analytical data, however, may not be directly comparable to existing data because of differences in procedures and QA objectives.

Assessment of statistical comparability will be based primarily on the use of field splits and internal and external PE samples. Specifics regarding the assessment of comparability within sample sets can be found in the Roux Associates, Inc.'s Evaluation and Validation of Data SOP in Appendix F.

As each stage of data collection is completed, the field and laboratory data will be qualitatively compared to previously collected data to evaluate comparability between data sets and identify potential discrepancies associated with different sampling methods or with field or laboratory-related contaminants.

Required Limit of Quantitation (Detection Limit):

Due to the anticipated matrix complexities, The site-specific limits of quantitation (LOQs) for the surface water and sediment analyses are provided in Tables 1A through 1D. Additional site specific LOQs will be developed for soil, LNAPL, lagoon residuals, and ground water. It is expected that soil, lagoon residuals, and LNAPL will have relatively high LOQs. The LOQs for supply wells are expected to be lower than the LOQs for ground water at other locations. For the USEPA SW-846 and other associated analyses, the detection limit(s) shall be arrived at using either the protocol as defined in 40 CFR Part 136 Appendix B but also taking into account the recovery of the analyte from the control matrix.

- The limit of quantitation shall be based on the variability of the blank response for the complete analytical procedure, or the variability for the signal-to-background response in a processed sample when there is not a detectable blank response. The detection limit will be established as three times the standard deviation of the blank or background response, adjusted for the amount of sample typically extracted and the final extract volume of the method (i.e., all dilution's and sample weight variables must be included in the calculation).

- Best professional judgment shall be used to adjust the limit of detection upward in cases where the transient occurrence of high instrument precision (i.e., low variability) results in a calculated limit of detection less than the absolute sensitivity of the analytical instrument. When no significant blank response is detectable, the limit of detection shall be estimated based on the standard deviation of low-level standard (concentrations at or near the expected instrument detection limit) responses.

15.2 Management of DQO Assessment

Assessment of the on-going ability to generate data of a known quality will be the primary responsibility of the PQAC and will be overseen by the Project Manager. As discussed previously in Sections 11.0 and 14.0, Roux Associates, Inc. will be responsible for performing audits for technical systems and data quality on an on-going basis.

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TABLES

Table 1A. Summary of Preliminary Remedial Goals and Numeric Data Quality Objectives for Soils†. BROS Superfund Site; Bridgeport, New Jersey.

Analyte	NJDEP ¹ Unrestricted Use SCC	NJDEP ¹ Restricted Use SCC	NJDEP ¹ Impact to Ground Water SCC	USEPA ² Generic SSL Inhalation/ Ingestion	USEPA ³ Generic SSL Migration to Ground Water	Proposed On-Property PRG	Proposed Off-Property PRG	Proposed Numeric DQO
Volatile Organic Compounds (mg/kg)								
Acetone	1000	1000	100	7800	0.8	100	100	50
Benzene	3	13	1	0.8	0.002	1	1	0.5
Toluene	1000	1000	500	650	0.6	500	500	250
Ethylbenzene	1000	1000	100	400	0.7	100	100	50
Xylenes	410	1000	10	410	9	10	10	5
2-Butanone	1000	1000	50			50	50	25
Semivolatile Organic Compounds (mg/kg)								
Phenanthrene								
Fluoranthene	2300	10000	100	3100	210	100	100	50
Pyrene	1700	10000	5000	2300	210	5000	1700	850
Chrysene	9	40	500	88	8	40	9	4.5
Benzoic Acid				310000	20	20	20	10
Bis(2-ethylhexyl)phthalate	49	210	100	46	180	100	49	24.5
Diethylphthalate	10000	10000	50	2000	23	50	50	25
Naphthalene	230	4200	100	3100	4	100	100	50
2-methylnaphthalene								
Benzo(b)fluoranthene	0.9	4	50	0.9	4	50	2	1
Benzo(k)fluoranthene	0.9	4	500	9	49	4	0.9	0.45
Benzo(a)pyrene	0.66	0.66	100	0.9	0.4	0.66	0.66	0.33
Benzo(g,h,i)perylene								
Benzo(a)anthracene	0.9	4	500	0.9	0.08	4	0.9	0.45
Indeno(1,2,3-cd)pyrene	0.9	4	500	0.9	0.7	4	0.9	0.45
Butylbenzyl Phthalate	1100	10000	100	930	810	100	100	50
Acenaphthene	3400	10000	100	4700	29	100	100	50
Anthracene	10000	10000	100	23000	590	100	100	50
Fuorene	2300	10000	100	3100	28	100	100	50
4-Methyl Phenol								
2,4-Dimethyl Phenol	1100	100000	10	1600	0.4	10	10	5
TPH	10000	10000	10000			10000	10000	5000
Polychlorinated Biphenyls (mg/kg)								
Total PCBs	0.49	2	50	1		2	0.49	0.245
Metals (mg/kg)								
Aluminum								
Arsenic	20	20		0.4	1	20	20	10
Barium	700	47000		5500	82	47000	700	350
Beryllium	2	2		0.1	3	2	2	1
Cadmium	1	100		78	0.4	100	1	0.5
Calcium								

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Table 1A. Summary of Preliminary Remedial Goals and Numeric Data Quality Objectives for Soils†. BROS Superfund Site; Bridgeport, New Jersey.

Analyte	NJDEP ¹ Unrestricted Use SCC	NJDEP ¹ Restricted Use SCC	NJDEP ¹ Impact to Ground Water SCC	USEPA ² Generic SSL Inhalation/ Ingestion	USEPA ² Generic SSL Migration to Ground Water	Proposed On-Property PRG	Proposed Off-Property PRG	Proposed Numeric DQO
Chromium								
Cobalt								
Copper	600	600		3.4		600	600	300
Iron								
Lead	400	600		400		600	400	200
Magnesium								
Manganese								
Mercury	14	270				270	14	7
Nickel	250	2400		1600	7	2400	250	125
Potassium								
Selenium	63	3100		390	0.3	3100	63	31.5
Silver	110	4100		390	2	4100	110	55
Sodium								
Thallium	2	2			0.04	2	2	1
Vanadium	370	7100		550	300	7100	370	185
Zinc	1500	1500		23000	620	1500	1500	750

¹ New Jersey Department of Environmental Protection (NJDEP) Soil Cleanup Criteria (SCC) for Unrestricted Use, Restricted Use and Impact to Ground Water. Last revised July 11, 1996.

² The lower of the United States Environmental Protection Agency (USEPA) Generic Soil Screening Levels (SSL) for Ingestion and Inhalation.

³ USEPA Generic SSL for Migration to Ground Water for a Dilution-Attenuation Factor of 1.

[†] Potential exposure routes for soil are provided on Figure 28.

mg/kg= Milligrams per Kilogram

DQO = Data Quality Objective. Equal to 50% of the PRG.

PRG = Preliminary Remedial Goal.

Table 1B. Summary of Preliminary Remedial Goals and Numeric Data Quality Objectives for Ground Water†.
BROS Superfund Site; Bridgeport, New Jersey.

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Analyte	NJDEP ¹ GWQC	Federal ² MCL	Proposed PRG	Proposed Numeric DQO
Volatile Organic Compounds (µg/L)				
1,2-Dichloroethene	10	5	5	2.5
Acetone	700		700	350
Benzene	1	5	1	0.5
Toluene	1000	1000	1000	500
Chlorobenzene	4		4	2
Ethylbenzene	700	700	700	350
Xylenes	40	1000	40	20
2-butanone	300		300	150
Trichloroethene	1	5	1	0.5
Tetrachloroethene	1	5	1	0.5
1,1,2-Trichloroethane	3		3	1.5
Vinyl Chloride	5	2	2	1
1,1-Dichloroethane	70			
1,1-Dichloroethene	2	7	2	1
1,1,2,2-Tetrachloroethane	2		2	1
1,2,4-Trimethylbenzene				
1,2,3-Trimethylbenzene				
1,2-Dichlorobenzene	600		600	300
1,2-Dibromo-3-chloropropane				
1,2-Dibromomethane				
2-Chlorotoluene				
4-Chlorotoluene				
1,2,3-Trichloropropane				
2-Hexanone				
Isopropyl benzene				
n-Propyl benzene				
n-Butyl benzene				
Dichlorofluoromethane				
Chloroform	6		6	3
sec-Butyl Benzene				
p-Isopropyl Toluene				
Carbon Disulfide				
Isopropyl Benzene				
Semivolatile Organic Compounds (µg/L)				
Phenanthrene				
Di-n-butyl phthalate	900		900	450
Fluoranthene	300		300	150
Pyrene	200		200	100
Benzo(a)anthracene				
Chrysene				
Bis(2-ethylhexyl)phthalate	30		30	15
Diethylphthalate		6	6	3
Naphthalene				
2-methylnaphthalene				
Benzo(a)fluoranthene				
Benzo(b)fluoranthene				
Benzo(k)fluoranthene				
Benzo(a)pyrene		0.2	0.2	0.1
Benzo(g,h,i)perylene				
Indeno(1,2,3-cd)pyrene				
Oil and grease	None Noticeable		None Noticeable	
Fluorene	300		300	150
Di-n-Octylphthalate	100		100	50
Dimethylphthalate				
Phenol	4000		4000	2000

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Table 1B. Summary of Preliminary Remedial Goals and Numeric Data Quality Objectives for Ground Water†.
BROS Superfund Site; Bridgeport, New Jersey.

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Analyte	NJDEP ¹ GWQC	Federal ² MCL	Proposed PRG	Proposed Numeric DQO
1,2-Dichlorobenzene	600		600	300
2,4-Methyl Phenol				
4-Methyl Phenol				
Anthracene	2000		2000	1000
Benzoic Acid				
Benzyl-Butyl Phthalate				
Bis(2-Chloroethyl)Ether	10		10	5
Isophrone	100		100	50
Benzyl Alcohol	2000		2000	1000
2,4-Dimethyl Phenol	100		100	50
2-Methyl Phenol				
4-Methyl Phenol				
Polychlorinated Biphenyls (µg/kg)				
Arochlor 1254				
Arochlor 1260				
Total PCBs	0.5	0.5	0.5	0.25
Metals (mg/kg)				
Aluminum	200		200	100
Antimony	20	6	6	3
Arsenic	8	50	8	4
Barium	2000	2000	2000	1000
Beryllium	20	4	4	2
Cadmium	4	5	4	2
Chromium	100	100	100	50
Iron	300		300	150
Lead	10		10	5
Manganese	50		50	25
Nickel	100		100	50
Thallium	10		10	5
Zinc	5000		5000	2500

¹ The Higher of the Ground Water Quality Criteria For Class IIA Aquifers or Practical Quantitation Level as Specified in N.J.A.C. 7:9-6.7(c).

² Federal Maximum Contaminants Levels at 40 CFR 141

† Potential exposure routes for soil are provided on Figure 28.

µg/ℓ = Micrograms per liter

DQO = Data Quality Objective. Equal to 50% of the PRG.

PRG = Preliminary Remedial Goal.

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Table 1C. Summary of Preliminary Remedial Goals and Numeric Data Quality Objectives for Surface Water†. BROS Superfund Site; Bridgeport, New Jersey.


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
Analyte	New Jersey ¹ SWQC	DRBC ² SQO	Ambient ⁴ Water Quality Criteria Freshwater	Ambient ⁵ Water Quality Criteria Salt Water	Ambient ⁶ Water Quality Criteria Human Health	Proposed PRG Little Timber Creek	Proposed PRG Gaventa And Swindell Ponds	Proposed Numeric DQO
Volatile Organic Compounds (µg/l)								
Acetone								
Benzene	0.15	12.5 ⁽³⁾			71	12.5	0.15	0.075
Toluene	7440				200000		7440	3720
Ethylbenzene	3030				29000		3030	1515
1,2,3-Trichlorobenzene								
2-Chlorotoluene								
Carbon Disulfide								
2-Hexanone								
Semivolatile Organic Compounds (µg/l)								
Di-n-butyl phthalate					12000			
Pyrene	797				11000		797	398.5
Bis(2-ethylhexyl)phthalate	1.76	1.04 ⁽³⁾			5.9	1.04	1.76	0.52
Naphthalene								
Anthracene					110000	110000	110000	55000
Di-n-octyl phthalate								
Polychlorinated Biphenyls (µg/l)								
Arochlor 1254			0.014	0.03	0.000045			
Arochlor 1260			0.014	0.03	0.000045			
Total PCBs	0.014	0.03				0.03	0.014	0.007
Metals (µg/l)								
Aluminum								
Antimony	12.2				4300		12.2	6.1
Arsenic	0.017	36	190	36	0.14	36	0.017	0.0085
Barium	2000						2000	1000
Beryllium		0.0232 ⁽³⁾				0.0232		0.0114
Cadmium	10	9.3	1	9.3		9.3	10	4.6
Calcium								
Chromium	160						160	80
Cobalt								
Copper		3.4	11	2.4		3.4		1.7
Iron								
Lead	5	8.5	2.5	8.1		8.5	5	2.5
Magnesium								
Manganese	100						100	50
Mercury	0.144	0.025	0.012	0.025	0.15	0.025	0.144	0.013
Nickel	516	8.3	160	8.2	4600	8.3	516	42
Potassium								
Selenium	10	71	5	71		71	10	5

Table 1C. Summary of Preliminary Remedial Goals and Numeric Data Quality Objectives for Surface Water†. BROS Superfund Site; Bridgeport, New Jersey. Page 2 of 2

Analyte	New Jersey ¹ SWQC	DRBC ² SQO	Ambient ⁴ Water Quality Criteria Freshwater	Ambient ⁵ Water Quality Criteria Salt Water	Ambient ⁶ Water Quality Criteria Human Health	Proposed PRG Little Timber Creek	Proposed PRG Gaventa And Swindell Ponds	Proposed Numeric DQO
Sodium								
Vanadium								
Zinc		86	110	81		86		43
Cyanide	22		5.2	1	220000		22	11

¹ New Jersey Surface Water Quality Criteria (SWCQ) for FW2 Waters at N.J.A.C. 7:9B-1.14.

² Delaware River Basin Commission (DRBC) Stream Quality Objectives(SQO) for Toxic Pollutants for the Protection of Aquatic Life in the Delaware River Estuary (Marine Objectives) unless otherwise noted. 

³ DRBC Stream Quality Objectives for Carcinogens in the Delaware River Estuary (Marine Objectives). 

⁴ Continuous Concentration Ambient Water Quality Criteria for Freshwater at 40 CFR 131.36.

⁵ Continuous Concentration Ambient Water Quality Criteria for Saltwater at 40 CFR 131.36.

⁶ Human Health Ambient Water Quality Criteria for Consumption of Organisms at 40 CFR 131.36.

† Potential exposure routes for surface water are provided on Figure 28.

µg/l = Micrograms per liter

DQO = Data Quality Objective. Equal to 50% of the PRG.

PRG = Preliminary Remedial Goal.

**Table 1D. Summary of Preliminary Remedial Goals and Numeric Data Quality Objectives for Sediments†. BROS
Superfund Site; Bridgeport, New Jersey.**

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Analyte	Ontario ¹ LEL	Long <i>et. al.</i> ² ER-L	ORNL ³ SQB	Ingersol <i>et. al.</i> ³ TEL-HA28	Washington ⁴ State AET-HA	Washington ⁴ State AET-MT	Proposed PRG	Proposed DQO
Volatile Organic Compounds (µg/kg)								
1,2-Dichloroethene			23				23	11.5
Acetone			64				64	32
Benzene			52				52	26
Toluene			786				786	393
Chlorobenzene			714				714	357
Ethylbenzene			4360				4360	2180
Xylenes			1210				1210	605
Hexane			12780				12780	6390
2-butanone								
Trichloroethene			1007				1007	503.5
Tetrachloroethene			2730				2730	1365
1,1,2-Trichloroethane			1310				1310	655
Semivolatile Organic Compounds (µg/kg)								
Phenanthrene	560	240		19	210000	15000	560	280
Di-n-butyl phthalate			42100				42100	21050
Fluoranthene	750	600		31	130000	21000	750	375
Pyrene	490	665		44	85000	23000	490	245
Benzo(a)anthracene	320	261		16	33000	7700	320	160
Chrysene	340	384		27	39000	11000	340	170
2-cyclohexen-1-ol								
2-cyclohexen-1-one								
1-H-3a,7-Methanoazulene,2,3								
Hexadeconic Acid								
Bis(2-ethylhexyl)phthalate								
Diethylphthalate			634				634	317
Naphthalene		160	407		2600	46000	407	203.5
2-methylnaphthalene								
Benzo(a)fluoranthene								
Benzo(k)fluoranthene	240						240	120
Benzo(a)pyrene	370			32	25000	11000	370	185
Benzo(g,h,i)perylene	170				21000	1400	170	85
Limonene								
Indeno(1,2,3-cd)pyrene	200				15000	760	200	100
Cineole								
Pentadeconic acid								
2-phenanthrenol,4b,5,6,7,8								
Tridecone								
Alpha-lobene								
Total PAHs	4000	4022			700000	170000	4000	2000
Low Molecular Weight PAHs		552			440000	74000	552	276
High Molecular Weight PAHs		1700			310000	91000	1700	850
TPH								
Oil and grease	0.15%						0.15%	0.00075

**Table 1D. Summary of Preliminary Remedial Goals and Numeric Data Quality Objectives for Sediments†. BROS
Superfund Site; Bridgeport, New Jersey.**

Page 2 of 2

Analyte	Ontario ¹ LEL	Long <i>et. al.</i> ² ER-L	ORNL ³ SQB	Ingersol <i>et. al.</i> ³ TEL-HA28	Washington ⁴ State AET-HA	Washington ⁴ State AET-MT	Proposed PRG	Proposed DQO
Polychlorinated Biphenyls (µg/kg)								
Arochlor 1254	60				350	7.3	60	30
Arochlor 1260	5						5	2.5
Total PCBs		50		32	820	21	50	25
Metals (mg/kg)								
Aluminum								
Antimony					64	3	3	1.5
Arsenic	6	8.2		11	150	40	6	3
Barium			20				20	10
Beryllium								
Cadmium	0.6	1.2		0.58	12	7.6	0.6	0.3
Calcium								
Chromium	26	81		36	280		26	13
Cobalt								
Copper	16	34		28	840		16	8
Iron			3%				3%	1.50%
Lead	31	46.7		35	720	260	31	15.5
Magnesium								
Manganese	460				1800		460	230
Mercury	0.2	0.15			2.7	0.56	0.2	0.1
Nickel	16	20.9		20			16	8
Potassium								
Selenium								
Silver	0.5	1			4.5		0.5	0.25
Sodium								
Thallium								
Vanadium								
Zinc	120	150		98	3200	520	120	60
Cyanide	0.1						0.1	0.05

¹ Indicates Lowest Effects Level (LEL) from *Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario*, Ontario Ministry of Environment and Energy, August 1993 used as Preliminary Remedial Goal (PRG).

² Indicates LEL not established. Effects Range Low (ER-L) from *Incidence of Adverse Biological Effects Within Ranges of Chemicals in Marine and Estuarine Sediments* by Long E. R., MacDonald, D. D., Smith, S. L., and Calder, F. D. 1993, Environmental Management, V. 19, No. 1.

³ Indicates LEL and ER-L not established. Sediment Quality Benchmark (SQB) from Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Sediment-Associated Biota, Environmental Sciences Division-Oak Ridge National Laboratory, June 1994 used as PRG.

⁴ Apparent Effects Thresholds (AET) for *Hyalella azteca* (HA) and Microtox (MT) from *Creation and Analysis of Freshwater Sediment Quality Values in Washington State*, Washington State department of Ecology, publication No. 97-323a, July 1997.

† Potential exposure routes for sediment are provided on Figure 28 of the Phase 2 RI/FS Work Plan.

µg/kg = Micrograms per kilogram.

mg/kg = Milligrams per kilogram.

DQO = Data Quality Objective. Equal to 50% of the PRG.

PRG = Preliminary Remedial Goal.

Table 2. Sample Types/Analyses in Task IIIA by Activity. BROS Phase 2 RI/FS; Bridgeport, New Jersey.

Activity	Matrix	Field Analyses	Laboratory Analyses
2: Soils Investigation	Soil	Photoionization Detector (PID) Screening, Non-Aqueous Phase Liquid (NAPL) Screening	TCL VOCs, TCL SVOCs, GRO/DRO, TPH, PCBs, TAL Metals, TOC, pH, Eh, Cation Exchange Capacity, Geotechnical Parameters, Waste Classification Parameters
3: Non Aqueous Phase Liquid (NAPL) Evaluation	LNAPL	PID Screening, NAPL Screening	TCL VOCs, PCBs, Lead, DRO/GRO, Specific Gravity, API Gravity, TOX, Viscosity, Waste Classification Parameters
4: Monitoring Well Installation	Soil	PID Screening, NAPL Screening, VOCs	TCL VOCs, TCL SVOCs, PCBs, TAL Metals, Geotechnical Parameters, Waste Classification Parameters
4: Ground Water Quality Evaluation	Water	pH, Conductivity, Eh, DO, Temperature, Ferrous Iron, Turbidity, VOCs	TCL VOCs, TCL SVOCs, TAL Metals (total and dissolved), TOC, Alkalinity, Hardness, Sulfate, Sulfide, Nitrate, Nitrite, Ammonia, TSS, TDS, Chloride, COD, CO ₂ , H ₂ S, TKN, Orthophosphate, Silica, Methane, Ethane, Ethene, Organic Acids, Waste Classification Parameters
5: Surface Water Sampling	Surface water	pH, Conductivity, Eh, DO, Temperature, Ferrous Iron	TCL VOCs, TCL SVOCs, TPH, PCBs, TAL Metals, Hardness, Alkalinity, TSS, TDS, TOC, Chloride, TKN, Sulfate, Sulfide, Nitrate, Nitrite, Ammonia
5: Sediment Sampling	Soil/Sediment	PID Screening, NAPL Screening, TPH, Lead	TCL VOCs, TCL SVOCs, TPH, DRO, GRO, PCBs, TCL Pesticides, TAL Metals, SPLP VOCs and Metals, Volatile Acid Sulfide, Cation Exchange Capacity, TOC, pH, Eh, Grain Size, Geotechnical Parameters
7: Ecological Sampling	Sediment	Temperature, Fish Identification	Macroinvertebrate Identification

TCL = Target Compound List
 VOC = Volatile Organic Compound
 SVOC = Semivolatile Organic Compound
 TPH = Total Petroleum Hydrocarbons
 GRO/DRO = Gasoline Range Organics/Diesel Range Organics
 PCBs = Polychlorinated Biphenyls
 TOC = Total Organic Carbon

TSS = Total Suspended Solids
 TDS = Total Dissolved Solids
 COD = Chemical Oxygen Demand
 TKN = Total Kjeldahl Nitrogen
 DO = Dissolved Oxygen
 TAL = Target Analyte List
 API = American Petroleum Institute
 TOX = Total Organic Halide

CO₂ = Carbon Dioxide
 H₂S = Hydrogen Sulfide

Table 3. Projected Number of Field Samples. BROS Phase 2 RI/FS; Bridgeport, New Jersey.

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Activity	Parameter	Field Samples	Field Duplicates ^a	Field Blanks ^b	Trip Blanks ^c	MS/MSD ^d	Total Laboratory Samples
2: Soils Investigation ⁽¹⁾	TCL-VOCs	302	15	15	15	15	362
	TCL-SVOCs	232	12	12	NA	12	280
	DRO/GRO	64	4	4	NA	4	76
	PCBs	232	12	12	NA	12	280
	TAL Metals	232	12	12	NA	12	280
	TOC, Eh, pH	238	12	0	NA	NA	274
	Geotechnical Parameters ^e	21	NA	NA	NA	NA	21
	Total Petroleum Hydrocarbons	232	12	12	NA	NA	256
	Cation Exchange Capacity	10	1	1	NA	NA	12
	Waste Classification Parameters	8	NA	NA	NA	NA	8
	- Ignitability						
	- Corrosivity						
	- Reactivity						
	- Toxicity (TCLP, VOCs, SVOCs, Pesticides, Metals)						
	- TOX						
	- BTU						
3: Non Aqueous Phase Liquid Evaluation NAPL	TCL-VOCs	4	1	0	1	1	7
	GRO/DRO	4	1	0	1	1	7
	Specific gravity	4	NA	NA	NA	NA	4
	API Gravity	4	NA	NA	NA	NA	4
	Viscosity	4	NA	NA	NA	NA	4
	Waste Classification Parameters	4	NA	NA	NA	NA	4
	- Ignitability						
	- Corrosivity						
	- Reactivity						
	- Toxicity (TCLP, VOCs, SVOCs, Pesticides, Metals)						
	- TOX						
	- BTU						
Soil	SPLP VOCs	15	1	1	1	1	19
	SPLP metals	15	1	1	NA	1	18
	TCL-VOCs	15	1	1	1	1	19

Table 3. Projected Number of Field Samples. BROS Phase 2 RI/FS; Bridgeport, New Jersey.

Page 2 of 4

Activity	Parameter	Field Samples	Field Duplicates ^a	Field Blanks ^b	Trip Blanks ^c	MS/MSD ^d	Total Laboratory Samples
4a: Ground-Water Quality Evaluation							
Soil	TCL-VOCs	70	4	4	6	4	88
	TCL-SVOCs	70	4	4	NA	4	82
	PCBs	70	4	4	NA	4	82
	TAL-Metals	70	4	4	NA	4	82
	TOC, Eh, pH	70	4	0	NA	NA	74
	Geotechnical Parameters ^e	10	NA	NA	NA	NA	10
Water ^{f, (2)}	TCL-VOCs	19	8	8	8	8	191
	TCL-SVOCs	43	3	3	NA	3	52
	TCL-BNs	61	4	4	NA	4	73
	TAL-Metals (total)	104	6	6	NA	6	122
	TAL-Metals (dissolved)	10	1	1	NA	1	13
	Iron-dissolved	43	3	3	NA	3	52
	TOC	104	6	0	NA	0	110
	Alkalinity	104	6	0	NA	0	110
	Hardness	104	6	0	NA	0	110
	sulfide/sulfate	104	6	0	NA	0	110
	nitrite/nitrate	104	6	0	NA	0	110
	chloride	104	6	0	NA	0	110
	COD	104	6	0	NA	0	110
	TSS	104	6	0	NA	0	110
	TDS	104	6	0	NA	0	110
	TKN	104	6	0	NA	0	110
	Methane	104	6	0	NA	0	110
	Ethane	104	6	0	NA	0	110
	Ethene	104	6	0	NA	0	110
	Organic Acids	104	6	0	NA	0	110
	Orthophosphate	104	6	0	NA	0	110

Table 3. Projected Number of Field Samples. BROS Phase 2 RI/FS; Bridgeport, New Jersey.

Activity	Parameter	Field Samples	Field Duplicates ^a	Field Blanks ^b	Trip Blanks ^c	MS/MSD ^d	Total Laboratory Samples
5: Surface Water Quality Evaluation ⁽¹⁾ (Water ^f)	TCL-VOCs	29	2	2	2	2	37
	TCL-SVOCs (total)	32	2	2	NA	2	38
	TCL-SVOCs (dissolved)	29	2	2	NA	2	35
	PCBs (total)	29	2	2	NA	2	35
	PCBs (dissolved)	29	2	2	NA	2	35
	TAL Metals (total)	35	2	2	NA	2	41
	TAL Metals (dissolved)	29	2	2	NA	2	35
	TPH	29	2	0	NA	2	33
	Hardness	19	1	NA	NA	NA	20
	Alkalinity	32	2	NA	NA	NA	34
	TSS	19	1	NA	NA	NA	20
	TDS	19	1	NA	NA	NA	20
	TOC	19	1	NA	NA	NA	20
	chloride	13	1	NA	NA	NA	14
	TKN	13	1	NA	NA	NA	14
	sulfate	13	1	NA	NA	NA	14
	sulfide	13	1	NA	NA	NA	14
	nitrate	13	1	NA	NA	NA	14
	nitrite	13	1	NA	NA	NA	14
5: Soil/Sediment Sampling ⁽¹⁾	TCL-VOCs	45	3	3	3	3	57
	TCL-SVOCs	45	3	3	NA	3	54
	PCBs	45	3	3	NA	3	54
	TAL Metals	45	3	3	NA	3	54
	TCL Pesticides	7	1	1	NA	1	10
	TPH	45	3	3	NA	3	54
	Volatile Acid Sulfide	15	1	NA	NA	NA	16
	Cation Exchange Capacity	15	1	NA	NA	NA	16
	TOC, pH, Eh	45	3	NA	NA	NA	48
	Grain Size	45	NA	NA	NA	NA	45
	Waste Classification Parameters	4	NA	NA	NA	NA	4
	- Ignitability						
	- Corrosivity						
	- Reactivity						
	- Toxicity (TCLP, VOCs, SVOCs, Pesticides, Metals)						
	- TOX						
	- BTU						
7: Ecological Evaluation Sediment	Micro-Organism Identification	TBD	TBD	TBD	NA	NA	TBD

Table 3. Projected Number of Field Samples. BROS Phase 2 RI/FS; Bridgeport, New Jersey.

- a. Duplicates to be collected at a rate of 5% of samples collected.
- b. Frequency estimates based on one blank per twenty samples, or one per day minimum.
- c. The number of trip blanks is estimated based on one trip blank per cooler.
- d. Matrix Spike/Matrix Spike Duplicate - one per twenty samples.
- e. Includes horizontal and vertical permeability, porosity, specific gravity, water content, and grain size.
- f. Field parameters include pH, Eh, conductivity, dissolved oxygen, temperature, and ferrous iron.
- (1) Additional samples will be collected for analysis but the locations and number of samples will be determined as initial results warrant.
- (2) Only includes samples though Second Round of sampling.

TCL = Target Compound List
VOC = Volatile Organic Compound
SVOC = Semivolatile Organic Compound
DRO/GRO = Diesel Range Organics/Gasoline Range Organics
PCB = Polychlorinated Biphenyls
TAL = Target Analyte List
VAS = Volatile Acid Sulfide
TOC = Total Organic Carbon
API = American Petroleum Institute

BN = Base Neutral Extractable Semivolatile Organic Compounds
COD = Chemical Oxygen Demand
TSS = Total Suspended Solids
TDS = Total Dissolved Solids
TKN = Total Kjeldahl Nitrogen
NA = Not Applicable
BTU = British Thermal Units
CEC = Cation Exchange Capacity
TOX = Total Organic Halides

Table 4. Field Quality Control Sample Frequency. BROS Phase 2 RI/FS; Bridgeport, New Jersey.

Parameters	Media	Trip Blank ^a	Field Blank ^b	Field Duplicates ^c	MS/MSD ^d
TCL Volatile Organic Compounds	Soil	1/20	1/20	1/20	1/20
TCL Semivolatile Organic Compounds	Soil	NA	1/20	1/20	1/20
DRO/GRO	Soil	1/20	1/20	1/20	1/20
TPH	Soil	NA	1/20	1/20	1/20
Polychlorinated Biphenyls	Soil	NA	1/20	1/20	1/20
TAL Metals	Soil	NA	1/20	1/20	1/20
Total Organic Carbon	Soil	NA	NA	1/20	NA
pH (off site)	Soil	NA	NA	1/20	NA
Eh (off site)	Soil	NA	NA	1/20	NA
Geotechnical Parameters ^e	Soil	NA	NA	NA	NA
Waste Characterization Parameters	Soil	NA	NA	NA	NA
Cation Exchange Capacity	Soil	NA	NA	1/20	NA
Acid Volatile Sulfide	Soil	NA	NA	1/20	NA
SPLP-VOCs	Soil	1/20	1/20	1/20	1/20
SPLP-Metals	Soil	NA	1/20	1/20	1/20
TCL Volatile Organics	Water	1/20	1/20	1/20	1/20
TCL Semivolatile Organics	Water	NA	1/20	1/20	1/20
TPH	Water	NA	1/20	1/20	1/20
GRO/DRO	Water	NA	1/20	1/20	1/20
Polychlorinated Biphenyls	Water	NA	1/20	1/20	1/20
TAL Metals	Water	NA	1/20	1/20	1/20
Chemical Oxygen Demand	Water	NA	NA	1/20	NA
Chloride	Water	NA	NA	1/20	NA
Alkalinity	Water	NA	NA	1/20	NA
Hardness	Water	NA	NA	1/20	NA
Sulfide/Sulfate	Water	NA	NA	1/20	NA
Nitrite/Nitrate	Water	NA	NA	1/20	NA
Ammonia	Water	NA	NA	NA	NA
Total Organic Carbon	Water	NA	NA	1/20	NA
TSS	Water	NA	NA	1/20	NA
TDS	Water	NA	NA	1/20	NA
Silica	Water	NA	NA	NA	NA
Organic Acids	Water	NA	NA	NA	NA
Total Kjeldahl Nitrogen	Water	NA	NA	1/20	NA
Orthophosphate	Water	NA	NA	1/20	NA
Methane	Water	NA	1/20	1/20	1/20
Ethane	Water	NA	1/20	1/20	1/20
Ethene	Water	NA	1/20	1/20	1/20
ph/Eh/Temperature/Specific Conductance/ Dissolved Oxygen/Turbidity	Water	NA	NA	1/20	NA
Ferrous iron	Water	NA	NA	1/20	NA
Carbon Dioxide	Water	NA	NA	1/20	NA
H ₂ S	Water	NA	NA	1/20	NA

Table 4. Field Quality Control Sample Frequency. BROS Phase 2 RI/FS; Bridgeport, New Jersey.

Parameters	Media	Trip Blank ^a	Field Blank ^b	Field Duplicates ^c	MS/MSD ^d
Waste Classification Parameters	Water	NA	NA	NA	NA
DRO/GRO	NAPL	1/20	1/20	1/20	NA
Specific Gravity	NAPL	NA	NA	1/20	NA
API Gravity	NAPL	NA	NA	1/20	NA
Viscosity	NAPL	NA	NA	1/20	NA
Total Organic Halide	NAPL	NA	NA	1/20	NA
Waste Classification Parameters	NAPL	NA	NA	NA	NA
TCL Volatile Organic Compounds	NAPL	1/20	1/20	1/20	1/20

- a. Where applicable, one per twenty or fewer field samples, or one per shipment container (VOC only), whichever is more frequent.
- b. Where applicable, one per twenty of fewer field samples, or one per day, whichever is most frequent.
- c. Where applicable, one per twenty or fewer field samples.
- d. Where applicable, one per twenty field samples or twice per week during sampling, whichever is more frequent.
- e. Off-site analysis for permeability, grain size, specific gravity, water content, and porosity.
- f. Field parameters.

TCL = Target Compound List
 TPH = Total Petroleum Hydrocarbons
 DRO/GRO = Diesel Range Organic / Gasoline Range Organic
 TAL = Target Analyte List
 TSS = Total Suspended Solids
 TDS = Total Dissolved Solid
 API = American Petroleum Institute
 NA = Not Applicable

Table 5. Laboratory Quality Control Sample Frequency. BROS Phase 2 RI/FS; Bridgeport, New Jersey

Parameter	Media	Method Blank ^a	MS ^a	MSD ^a	Laboratory Replicate ^a	Analysis Method
TCL Volatile Organic Compounds	Soil	1/20	1/20	1/20	NA	8260B ^b
TCL Semivolatile Organic Compounds	Soil	1/20	1/20	1/20	NA	8270C ^b
Total Petroleum Hydrocarbons	Soil	1/20	1/20	1/20	NA	8015B ^b
GRO Organics	Soil	1/20	1/20	1/20	NA	8015B ^b
DRO Organics	Soil	1/20	1/20	NA	NA	8015B ^b
Polychlorinated Biphenyls	Soil	1/20	1/20	1/20	NA	8082 ^b
TAL Metals	Soil	1/20	1/20	NA	1/20	6020 / 6010B / 7471a ^b
Total Organic Carbon	Soil	1/20	1/20	1/20	1/20	415.1M / 9060 ^b
pH (off site)	Soil	NA	NA	NA	1/10	9045C ^b
Eh (off site)	Soil	NA	NA	NA	1/20	ASTM D1498 ^c
Grain Size	Soil	NA	NA	NA	NA	ASTM D422-63 ^c
Porosity	Soil	NA	NA	NA	NA	Calculated
Permeability	Soil	NA	NA	NA	NA	ASTM D5084-90 ^c
Specific Gravity	Soil	NA	NA	NA	NA	ASTM D4052 ^c
Water Content	Soil	NA	NA	NA	NA	ASTM D2216 ^c
Cation Exchange Capacity	Soil	1/20	NA	NA	1/20	9081 ^c
Acid Volatile Sulfide	Soil	1/20	1/20	1/20	1/20	AVS/SEM
SPLP-Metals	Soil	1/20	1/20	1/20	1/20	1312 / 6010B / 6020 / 7470A
SPLP-VOCs	Soil	1/20	1/20	NA	1/20	1312 / 8260B
Waste Classification Parameter	Soil	NA	NA	NA	NA	See Below
TCL Volatile Organics	Water	1/20	1/20	1/20	1/20	8260B ^b
TCL Volatile Organics	Water	NA	NA	NA	NA	524.2 Rev. 4 ^f
TCL Semivolatile Organics	Water	1/20	1/20	1/20	1/20	8270C ^b
Total Petroleum Hydrocarbons	Water	1/20	1/20	1/20	1/20	8015B ^b
GRO Organics	Water	1/20	1/20	1/20	1/20	8015B ^b
DRO Organics	Water	1/20	1/20	NA	1/20	8015B ^b
Polychlorinated Biphenyls	Water	1/20	1/20	1/20	1/20	8082 ^b
TAL Metals	Water	1/20	1/20	NA	1/20	6010B / 6020 / 7470A ^b
Chemical Oxygen Demand	Water	1/20	1/20	1/20	1/20	410.4 ^d
Chloride	Water	NA	1/20	1/20	1/20	325.2 / 325.3 ^d
Alkalinity	Water	NA	1/20	1/20	1/20	310.1 ^d
Hardness	Water	1/20	1/20	1/20	1/20	130.2 ^d
Sulfide	Water	1/20	1/20	1/20	1/20	376.2 ^d
Sulfate	Water	1/20	1/20	1/20	1/20	375.4 ^d
Nitrite	Water	1/20	1/20	1/20	1/20	353.2 ^d
Nitrate	Water	1/20	1/20	1/20	1/20	353.2 ^d
Ammonia	Water	1/20	1/20	1/20	1/20	350.1 ^d
Total Organic Carbon	Water	1/20	1/20	1/20	1/20	415.1 ^d / 9060 ^b
Organic Acids	Water	1/20	NA	NA	NA	column separation ^g
TSS	Water	1/20	1/20	1/20	1/20	160.2 ^d
TDS	Water	1/20	1/20	1/20	1/20	160.1 ^d
Total Kjeldahl Nitrogen	Water	1/20	1/20	1/20	1/20	351.2 ^d
Silica	Water	1/20	1/20	1/20	1/20	370.1 ^d
Orthophosphate	Water	NA	NA	1/20	1/20	365.1/365.3 ^d

Table 5. Laboratory Quality Control Sample Frequency. BROS Phase 2 RI/FS; Bridgeport, New Jersey

Parameter	Media	Method Blank ^a	MS ^a	MSD ^a	Laboratory Replicate ^a	Analysis Method
Methane	Water	1/20	1/20	1/20	1/20	M8000 ^b
Ethane	Water	1/20	1/20	1/20	1/20	M8000 ^b
Ethene	Water	1/20	1/20	1/20	1/20	M8000 ^b
Carbon Dioxide	Water	1/20	NA	NA	1/20	A4500 ^d
Hydrogen Sulfide	Water	1/20	NA	NA	1/20	3810 / 8015 modified ^b
Waste Classification Parameters	Water	NA	NA	NA	NA	See Below
DRO/GRO	NAPL	1/20	NA	NA	1/20	8015 ^b
Specific Gravity	NAPL	NA	NA	NA	NA	ASTM D1298/ASTM D4052 ^c
API Gravity	NAPL	NA	NA	NA	NA	ASTM D1298/ASTM D287 ^c
Total Organic Halide	NAPL	NA	1/20	1/10	1/10	9020B ^b
Viscosity	NAPL	NA	NA	NA	NA	ASTM
TCL Volatile Organic Compounds	NAPL	1/20	1/20	1/20	1/20	8260B ^b
Waste Classification Parameters	NAPL	NA	NA	NA	NA	See Below

- Where applicable, one per twenty or fewer field samples, or one per analytical batch, whichever is more frequent.
- Test Methods for Evaluating Solid Wastes.
- American Society for Testing and Materials.
- Standard Methods for the Examination of Water and Wastewater.
- Aquatic Microbial Ecology.
- Typical QC for EPA 524.2 Rev.4 is an LFB (Lab Fortified Blank) per tune period.
- Based on Leener, 1981, Comprehensive Approach to Preparative Isolation and Fractionation of Dissolved Organic Carbon from Natural Waters and waste Waters.

Waste classifications methods include: 1311 / 8260B / 8270B / 8082 / 8081A / 8151A^b; ignitability by 40 CFR 261.1; corrosivity and reactivity by SW-846 Chapter 7^b; BTU by D240-87^c.

TCL = Target Compound List
TAL = Target Analyte List
DRO/GRO = Diesel Range Organics/Gasoline Range Organics
TSS = Total Suspended Solids
TDS = Total Dissolved Solids
API = American Petroleum Institute
NA = Not Applicable
MeCl = Methylene Chloride

Table 6. Preservation, Holding Times and Sample Containers. BROS Phase 2 RI/FS; Bridgeport, New Jersey

Parameter	Preservation	Holding Time ^a	Containers
Aqueous VOCs	HCl to pH<2, no headspace 4°C until analysis	14 days	3 x 40 ml vials w/teflon septum, glass
Aqueous VOCs (524.2)	HCl to pH<2, ascorbic acid, no headspace 4°C until analysis	14 days	4 x 40 ml vials w/teflon septum, glass
Aqueous SVOCs	Na ₂ S ₂ O ₃ 4°C until extraction and analysis	7 days until extraction, 40 days until analysis	2 x 1000 ml amber bottles w/teflon lined lid, glass
Aqueous PCBs	Na ₂ S ₂ O ₃ 4°C until extraction and analysis	7 days until extraction, 40 days until analysis	2 x 1000 ml amber bottles w/teflon lined lid, glass
Aqueous GRO	HCl to pH<2, 4°C, no headspace	14 days	3 x 40 ml vials, glass
Aqueous DRO	HCl to pH<2, 4°C	7 days to extraction 40 days to analysis	2 x 1000 ml amber bottles w/ teflon lid, glass
Aqueous TPH (GC/FID)	HCl to pH<2, 4°C	7 days to extraction 40 days to analysis	2 x 1000 ml amber bottles w/ teflon lid, glass
Organic Acids			
Acid Volatile Sulfide	4°C until analysis	none	4 oz glass jar w/teflon lined lid
LNAPL GRO	4°C, no headspace	14 days	2 x 40 ml vials w/teflon septum, glass, half full
LNAPL DRO	4°C, no headspace	14 days	2 x 40 ml vials w/teflon septum, glass, half full
LNAPL VOCs	4°C, no headspace	14 days	2 x 40 ml vials w/teflon septum, glass, half full
Chemical Oxygen Demand	4°C until analysis H ₂ SO ₄ to pH<2	28 days	100 ml plastic/glass bottle
Carbon Dioxide	4°C until analysis, no headspace	N.A.	2 x 40ml vials, glass
Hydrogen Sulfide			
Sulfate	4°C until analysis	28 days	100 ml plastic/glass bottle
Sulfides	4°C until analysis NaOH/Zn Ac	7 days	500 ml Glass bottle
Nitrate	H ₂ SO ₄ TO pH<2, 4°C	28 days	500 ml plastic/glass bottle
Nitrite	4°C until analysis	2 days	500 ml plastic/glass bottle
Ammonia	H ₂ SO ₄ TO pH<2, 4°C	28 days	500 ml plastic/glass bottle
Total Suspended Solids	4°C until analysis	7 days	500 ml plastic/glass bottle
Total Dissolved Solids	4°C until analysis	7 days	500 ml plastic/glass bottle
Alkalinity	4°C until analysis	14 days	200 ml plastic/glass bottle
Total Kjeldahl Nitrogen	4°C until analysis H ₂ SO ₄ to pH<2	28 days	500 ml plastic/glass bottle
Aqueous Total Organic Carbon	4°C until analysis HCL or H ₂ SO ₄ to pH<2	28 days	125 ml glass bottle
Hardness	HNO ₃ , pH <2, 4°C	180 days until analysis	100 ml plastic/glass
Methane, Ethene, Ethane	4° C until analysis	14 days until analysis	2 - 40 ml vials
Viscosity	4° C until analysis	NA	500 ml glass
Orthophosphate	Filter on site, 4° C	48 hours	100 ml plastic/glass
Chloride	4° C	28 days	500 ml plastic/glass
Dissolved Oxygen	4°C, no headspace	Analyze immediately	300 ml glass bottle
Aqueous Metals	HNO ₃ to pH<2	180 days	1 liter plastic bottle
(Mercury)		(28 days)	(included above)
Soil VOCs	4°C, no headspace	14 days ^b	4 oz glass jar w/teflon lined lid
Silica	4° C until analysis	28 days	200 ml plastic bottle

Table 6. Preservation, Holding Times and Sample Containers. BROS Phase 2 RI/FS; Bridgeport, New Jersey

Parameter	Preservation	Holding Time ^a	Containers
Soil VOCs	Methanol (NJDEP Method)	14 days collection to analysis	1 x 40ml vial w/methanol 10g soil into 25ml methanol w/surrogate stds.
Soil SVOCs	4°C until extraction and analysis	14 days until extraction ^c 40 days collection to analysis	500 ml glass jar w/teflon lined lid
Soil Metals (Mercury)	4°C until analysis	180 days ^d (26 days) ^e	500 ml glass jar w/teflon lined lid (included above)
Soil PCBs	4°C until extraction and analysis	14 days until extraction ^b 40 days until analysis	500 ml glass jar w/teflon lined lid 500 ml glass jar w/teflon lined lid
Total Organic Carbon (Soils)	4°C until extraction and analysis	28 days	4 oz glass jar w/teflon lined lid
GRO – 5030 (Sediment)	4°C, no headspace	14 days ^b	4 oz jar w/teflon lined lid
GRO – 5035 (Soil)	Methanol (NJDEP)	14 days collection to analysis	1 x 40ml vial w/methanol 10g soil into 25ml methanol w/surrogate stds.
DRO	4°C until analysis	7 days extraction 40 days analysis	500 ml glass jar
TPH by GC/FID	4°C until analysis	14 days until extraction 40 days until analysis	500 ml glass jar
SPLP-VOCs	4°C until analysis	14 days ^b	4 oz glass jar w/teflon lined lid
SPLP-Metals (Mercury)	4°C until analysis	180 days ^d (28 days) ^e	500 ml glass jar w/teflon lined lid 500 ml glass jar w/teflon lined lid
Grain Size	4°C	none	500 ml glass jar
Permeability	none	none	Shelby Tube
Porosity	none	none	Shelby Tube
Specific Gravity	none	none	500 ml glass jar
Water Content	4°C until analysis	none	4 oz glass jar w/teflon lined lid
Cation Exchange Capacity	4°C until analysis	none	500 ml glass jar
Acid Volatile Sulfides	4°C until analysis	none	500 ml water / 50 g soil
Eh	4°C until analysis	1 day	50 g glass jar
pH	4°C until analysis	14 days (soils)	50 g glass jar
Specific gravity (NAPL)	none	none	250 ml glass
API gravity (NAPL)	none	none	250 ml glass
Viscosity (NAPL)	none	none	250 ml glass
Total Organic Halide (NAPL)	none	none	50 ml glass
TCL-VOCs (NAPL)	4°C, no headspace	14 days	1 x 40 ml vial w/teflon septum, glass

^a From collection until analysis unless otherwise specified.

^b 14 days from field to TCLP extraction/14 days from extraction to analysis.

^c 14 days from field to TCLP extraction/7 days from TCLP extraction to preparative extraction/40 days to analysis.

^d 180 days from field to TCLP extraction/180 days from extraction to analysis.

^e 28 days from field to TCLP extraction/28 days from extraction to analysis.

VOC = Volatile Organic Compounds
SVOC = Semi Volatile Organic Compounds
PCB = Polychlorinated Biphenyls
GRO = Gasoline Range Organics

DRO = Diesel Range Organics
NAPL = Non-Aqueous Phase Liquids
API = American Petroleum Institute

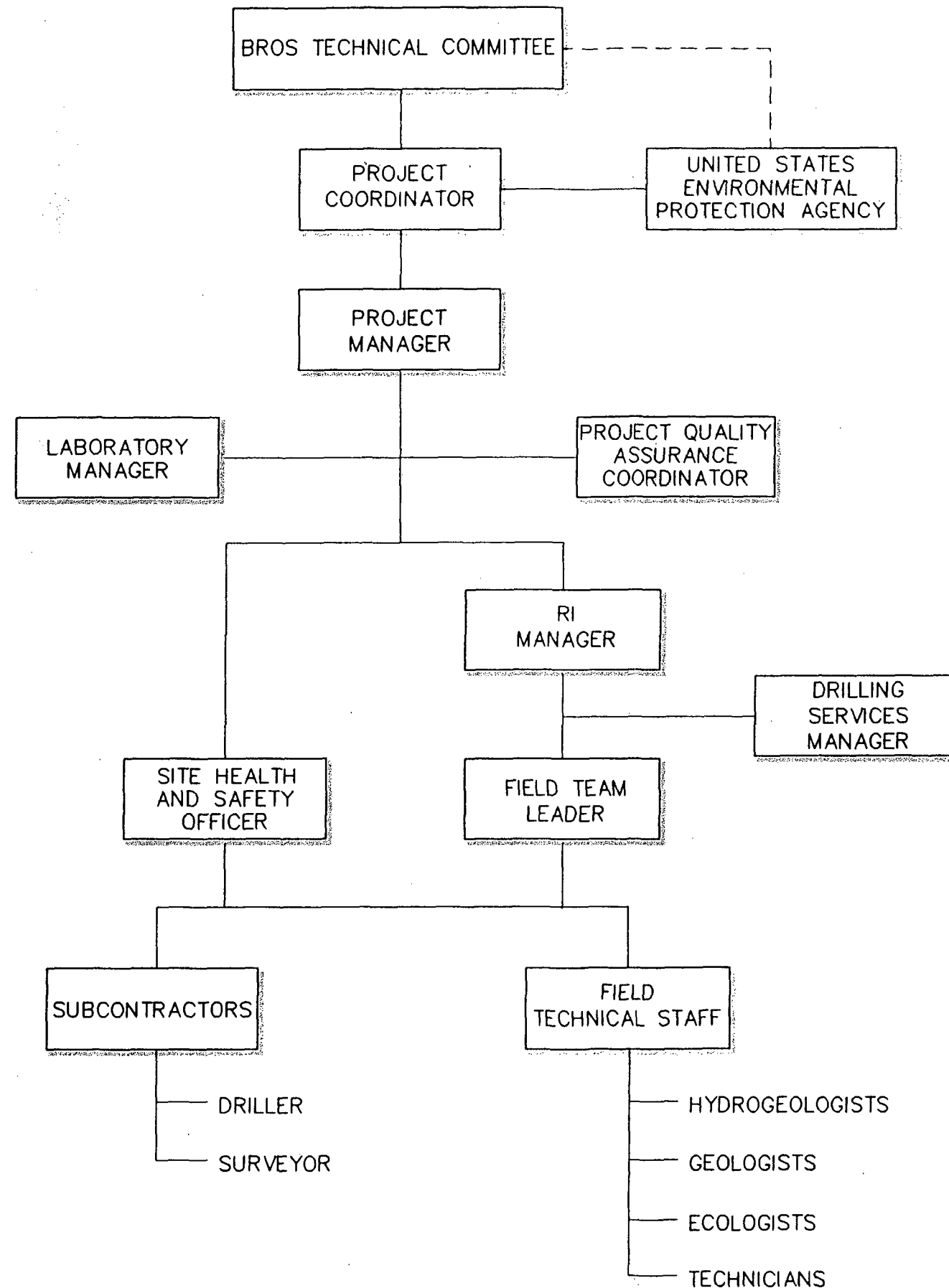
Note: Bottles may be modified since multiple analyses can be taken from a single bottle. This table is for single analysis only.

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Table 7. Field Equipment Calibration Requirements and Maintenance Schedule. BROS Phase 2 RI/FS; Bridgeport, New Jersey.

Equipment Type	Calibration Schedule	Calibration Requirements	Maintenance Schedule
Photoionization Detector	Daily	Appendix B of SAP	Recharge or replace battery. Regularly clean lamp window. Regularly clean and maintain the instrument and accessories.
pH Meter	Daily	Appendix B of SAP	Per manufacturer's specifications and as needed based on calibration checks.
Eh Meter	Daily	Appendix B of SAP	Per manufacturer's specifications and as needed based on calibration checks.
Specific Conductance Meter	Daily	Appendix B of SAP	Per manufacturer's specifications and as needed based on calibration checks.
Thermometer	Bi-weekly	Appendix B of SAP	Regularly check for breakage.
Personal Protective Equipment	Daily	Not Applicable	Integrity/function test prior to donning equipment. Visual inspection for defects/leakage for all reusable gear.
Magnetometer	Not Applicable	Not Applicable	Replace batteries as necessary.
Surveying Instruments	Annually	Return to Manufacturer	Regularly clean instrument lenses.
Interface Probe	Daily	Appendix B of SAP	Replace batteries as necessary.





Title:			
PROJECT ORGANIZATION CHART			
BRIDGEPORT RENTAL & OIL SERVICES SITE LOGAN TOWNSHIP, NEW JERSEY			
Prepared For:			
BROS TECHNICAL COMMITTEE			
ROUX ROUX ASSOCIATES INC Environmental Consulting & Management	Compiled by: J.A.L.	Date: 06/17/97	Figure 1
	Prepared by: J.S.G.	Scale: N.T.S.	
	Project Mgr: N.R.	Revision:	
	Proj No: 49301J05	File No: 49301063	

SOIL SAMPLE COLLECTED FROM BORING
L-8 FROM A DEPTH OF 12 TO 14 FEET.



LOT #	
SAMPLE ID	L-8/SO/12-14
SAMPLED BY	NRR
DATE	7/19/98
TIME	17:00
LOCATION	BROS
PRESERVATIVE	—
ANALYSIS	TPH
CLIENT	49301J

01 San Leandro Street, Oakland, California 94603
(510) 562-4988 (800) 233-8425

ROUX ASSOCIATES, INC.
PROJECT NUMBER

TO BE ANALYZED FOR
TOTAL PETROLEUM HYDROCARBONS

A FILTERED GROUND WATER
SAMPLE FROM MW-10B.



SAMPLE ID	
MW-10B/GW/F	
SAMPLED BY	NRR
DATE	6/24/97
TIME	14:17
LOCATION	BROS
PRESERVATIVE	HCL
ANALYSIS	TAL METALS
CLIENT	49301J

9601 San Leandro Street, Oakland, California 94603
(510) 562-4988 (800) 233-8425

PRESERVED WITH
HYDROCHLORIC ACID

TO BE ANALYZED FOR
TAL METALS

Title:

EXAMPLES OF COMPLETED SAMPLE LABELS

BRIDGEPORT RENTAL & OIL SERVICES SITE
LOGAN TOWNSHIP, NEW JERSEY

Prepared For:

BROS TECHNICAL COMMITTEE

ROUX
ROUX ASSOCIATES INC
Environmental Consulting
& Management

Compiled by: B.G.

Date: 06/06/98

Figure

Prepared by: J.S.G.

Scale: SHOWN

Project Mgr: N.R.

Revision:

Proj No: 49301J05

File No: 49301106

2



ATTACHMENTS

LABORATORY QUALITY ASSURANCE PLAN

Roux Associates, Inc.
Bros Superfund Site
Bridgeport, NJ

July 28, 1998

WARNING: The information contained herein is of a highly confidential and proprietary nature. Lancaster Laboratories specifically prohibits the dissemination or transfer of this information to any person or organization not directly affiliated with the project for which it was prepared.



Lancaster Laboratories
A division of Thermo Analytical Inc.

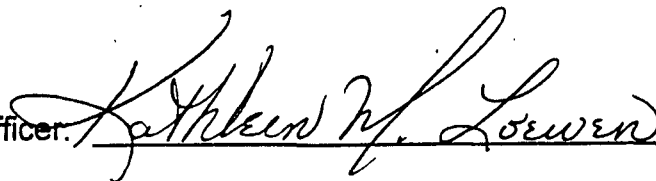
301107

1. Laboratory Quality Assurance Plan

This document provides the laboratory portion of the response to EPA's *Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans* QAMS-005/80, Sections 5.1 through 5.16 as revised December 29, 1980, and EPA-600/4-83-004, February 1983. Guidance was also obtained from *Preparation Aids for the Development of Category 1 Quality Assurance Project Plans*, Office of Research and Development, USEPA, EPA/600/8-91/003, February 1991.

As much as possible, the procedures in this document have been standardized to make them applicable to all types of environmental monitoring and measurement projects. However, under certain site-specific conditions, all of the procedures discussed in this document may not be appropriate. In such cases it will be necessary to adapt the procedures to the specific conditions of the investigation.

Quality Assurance Officer:



301108

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1. Title Page	1	0	07/28/98
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6. Sampling Procedures	4	0	07/28/98
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9. Analytical Procedures	19	0	07/28/98
10. Data Reduction, Validation, and Reporting	9	0	07/28/98
11. Internal Quality Control Checks	19	0	07/28/98
12. Performance and Systems Audits	11	0	07/28/98
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14. Specific Routine Procedures Used to Assess Data Precision, Accuracy, and Completeness	4	0	07/28/98
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Appendix A - Example Reporting Forms	80	0	07/28/98

3. Project Description

This quality assurance project plan provides specific quality assurance and quality control procedures involved in the generation of data of acceptable quality and completeness. Tests will be performed according to the analytical methodology set forth in the USEPA SW-846 3rd Edition, Update III, 1996, and USEPA Methods for Chemical Analysis of Water and Wastes. SW-846 provides specific analytical procedures to be used and defines the specific application of these procedures. Proven instruments and techniques will be used to identify and measure the concentrations of volatiles, semivolatiles, and pesticide compounds and/or the inorganic elements. The laboratory will employ state-of-the-art GC/MS and/or GC procedures to perform all organic analyses, including all necessary preparation for analysis. Inorganic analyses will be performed using graphite furnace atomic absorption spectrophotometry (AA), inductively coupled plasma spectroscopy, or cold vapor AA. Wet chemical analyses will use appropriate instrumentation. The client is responsible for providing specifics on the project site.

Test Methods for Evaluating Solid Waste - Physical/Chemical Methods, SW-846, 3rd Edition, Update III, December 1996.

Methods for Chemical Analysis of Water and Wastes (EPA 600/4-79-020, EPA 600/R-95-131).

4. Project Organization

The objectives of the laboratory Quality Assurance Program are to establish procedures which will ensure that data generated in the laboratory are within acceptable limits of accuracy and precision, to ensure that quality control measures are being carried out, and to ensure accountability of the data through sample and data management procedures. To this end, a Quality Assurance Department has been established. The Quality Assurance Officer reports directly to the President of Lancaster Laboratories and has no direct responsibilities for data production, thus avoiding any conflict of interest.

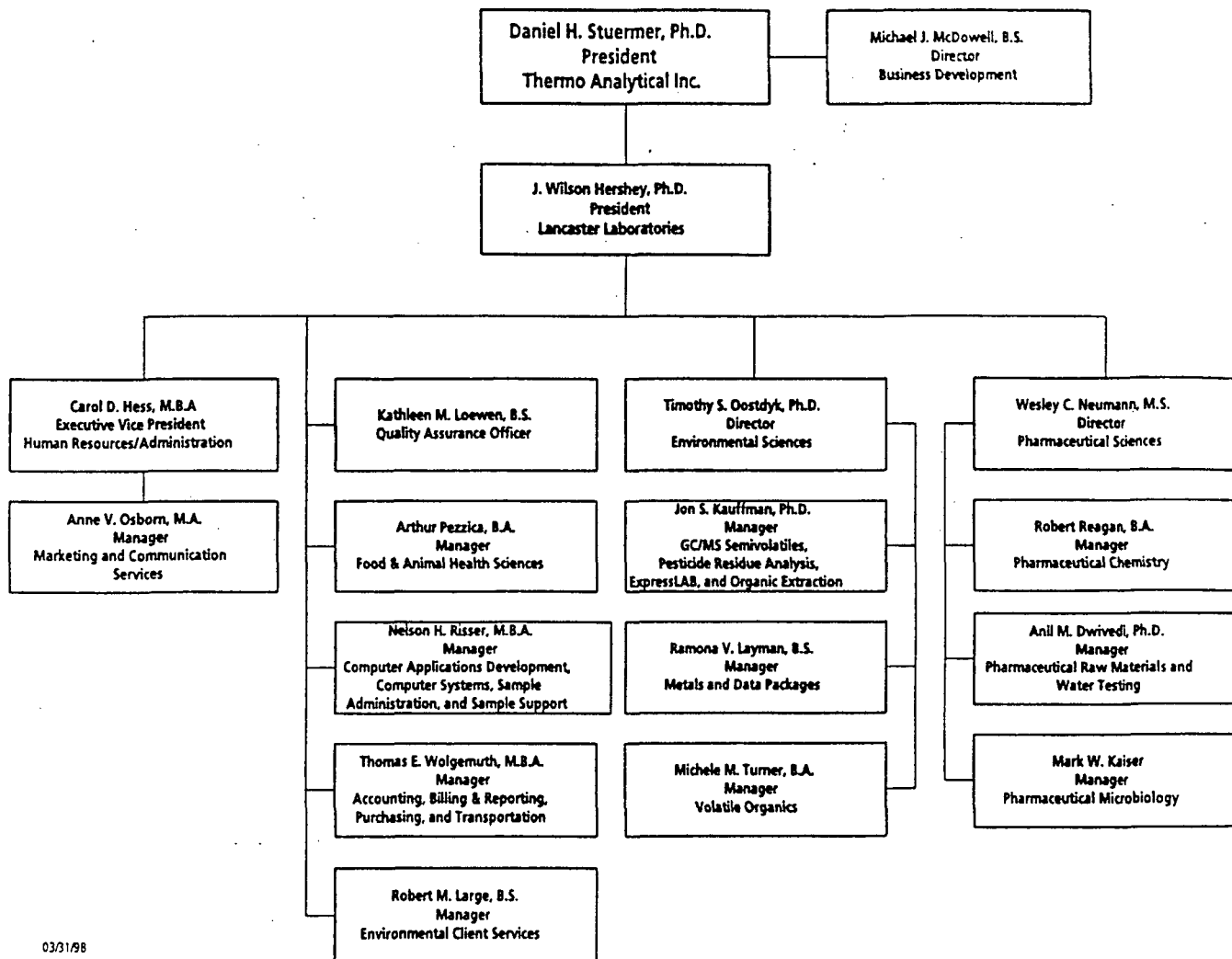
The attached organizational charts show key managerial personnel. Resumes of key individuals may be found in the enclosed *Qualifications Manual*.

The Sample Administration Group will be responsible for receiving samples, signing the external chain of custody, checking sample condition, assigning unique laboratory sample identification numbers, and initiating internal chain-of-custody forms. Sample Support personnel will be responsible for assigning storage locations, checking and adjusting preservation, homogenizing the sample as needed, and sample discard.

Group leaders listed in each technical area are responsible for performing laboratory analyses, quality control as specified in the methods, instrument calibration, and technical data review. Data is reported using a computerized sample management system, which tracks sample progress through the laboratory and generates client reports when all analyses are complete. Quality control data is entered onto the same system for purposes of charting and monitoring data quality.

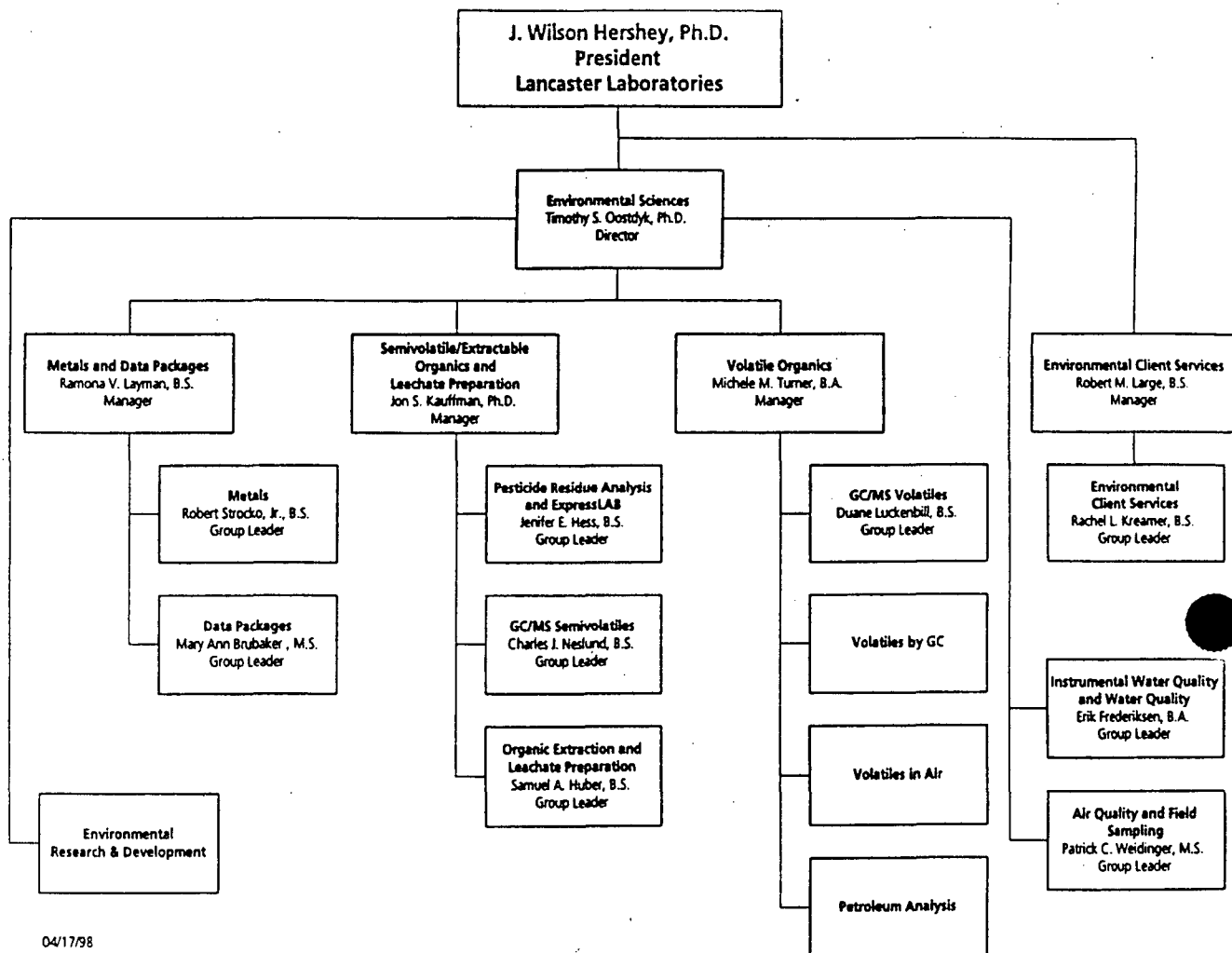
The Quality Assurance Department is responsible for reviewing quality control data, conducting audits in the laboratory and reporting findings to management, maintaining current copies of all analytical methods, maintaining copies of computer code used to calculate and report results, submitting blind samples to the laboratory, and ensuring that appropriate corrective action is taken when quality problems are observed.

Data package deliverables are available upon request. The Quality Assurance Department reviews the contents of the deliverables for completeness and to be sure that all quality control checks were performed and met specifications. This step includes review of holding times, calibrations, instrument tuning, blank results, duplicate results, matrix spike results, surrogate results, and laboratory control samples (where applicable). Every attempt to meet specifications will be made, and any item outside of the specifications will be noted in the narrative. The laboratory will not validate data with regard to usability since this generally requires specific knowledge about the site.



03/31/98

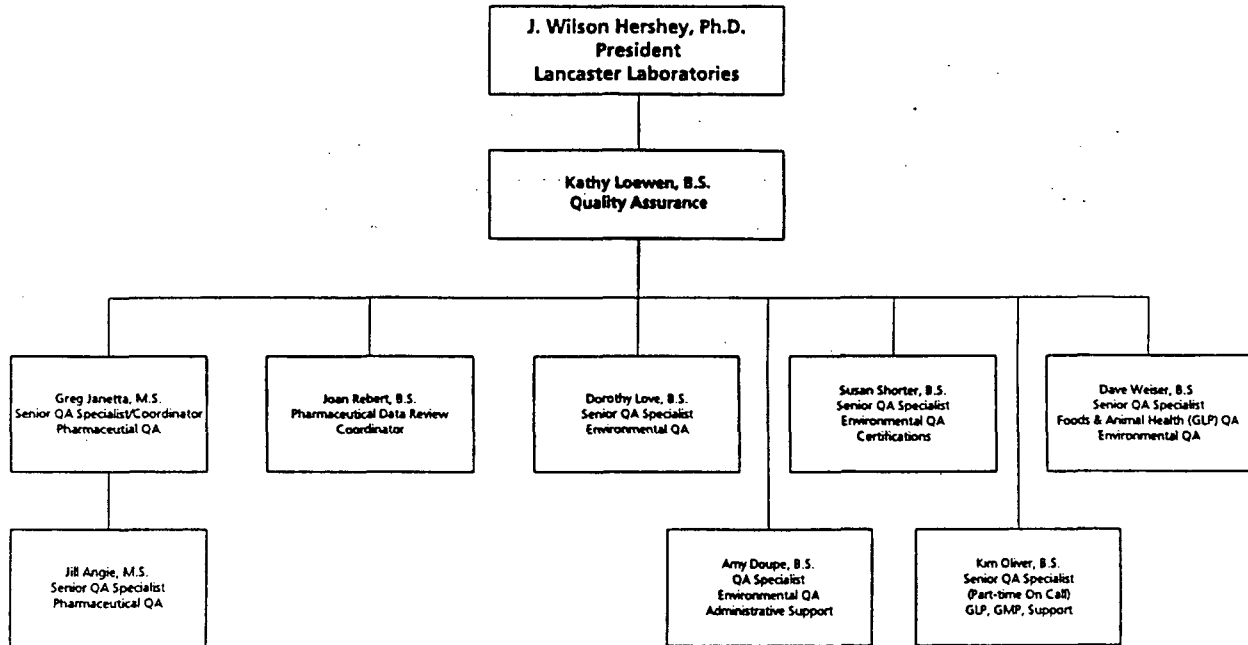
Environmental Sciences



04/17/98

301114

Quality Assurance



06/23/98

301115

5. QA Objectives for Measurement Data

Quality assurance is the overall program for assuring reliability of monitoring and measurement data. Quality control is the routine application of procedures for obtaining set standards of performance in the monitoring and measurement process. Data quality requirements are based on the intended use of the data, the measurement process, and the availability of resources. The quality of all data generated and processed during this investigation will be assessed for precision, accuracy, representativeness, comparability, and completeness. These specifications will be met through precision and accuracy criteria as specified in Section 11. Detection limits are presented in Section 9.

Precision - Precision is determined by measuring the agreement among individual measurements of the same property, under similar conditions. The laboratory objective is to equal or exceed the precision demonstrated for the applied analytical method on comparable samples. The degree of agreement is expressed as the relative percent difference (RPD%). Evaluation of the RPD% is based on statistical evaluation of past lab data or guidelines within the methods for organic and inorganic analyses. External evaluation of precision is accomplished by analysis of standard reference material and interlaboratory performance data.

Accuracy - Accuracy is a measure of the closeness of an individual measurement to the true or expected value. Analyzing a reference material of known concentration or reanalyzing a sample which has been spiked with a known concentration/amount is a way to determine accuracy. Accuracy is expressed as a percent recovery (%R). Evaluation of the %R is based on statistical evaluation of past lab data or guidelines within the methods for organic and inorganic analyses.

Representativeness - Representativeness expresses the degree to which data accurately represents the media and conditions being measured. The representativeness of the data from the sampling site will depend on the sampling procedure. Sample collection is the responsibility of the client. Samples will be

homogenized, if required, as part of the laboratory sample preparation. By comparing the quality control data for the samples against other data for similar samples analyzed at the same time, representativeness can be determined for this objective.

Comparability - Comparability conveys the confidence with which one set of data can be compared to another. The analytical results can be compared to other laboratories by using traceable standards and standard methodology and consistent reporting units. The Laboratory Quality Assurance Program documents internal performance, and the interlaboratory studies document performance compared to other laboratories.

Completeness - Completeness is a measure of the quantity of valid data acquired from a measurement process compared to the amount that was expected to be acquired under the measurement conditions. The completeness of an analysis can be documented by including in the data deliverables sufficient information to allow the data user to assess the quality of the results. Additional information will be stored in the laboratory archives, both hard copy and magnetic tape. Quality Assurance standard operating procedures (SOPs) are in place to provide traceability of all reported results.

To ensure attainment of the quality assurance objectives, SOPs are in place detailing the requirements for the correct performance of laboratory procedures. The laboratory SOPs fall under five general categories:

1. Corporate policy
2. Quality assurance
3. Sample administration
4. General laboratory procedures
5. Analytical (i.e., methods, standard preps., instrumentation)

Section No. 5
Revision No. 0
Date: 07/28/98
Page 3 of 4

All SOPs are approved by the QA Department prior to implementation. The distribution of current SOPs and archiving of outdated ones are controlled through a master file. Table 5-1 provides an index of QA SOPs in place in support of the Quality Assurance objectives. These requirements are supplemented by the procedures in the laboratory and analytical SOPs.

Table 5-1	
Document #	Document Title
QA-101	Sample Collection
QA-102	Sample Log-in
QA-103	Sample Storage and Discard
QA-104	Internal Chain-of-Custody Documentation
QA-105	Analytical Methods Manual
QA-106	Validation and Authorization of Analytical Methods
QA-107	Analytical Methods for Nonstandard Analyses
QA-108	Subcontracting to Other Laboratories
QA-109	Laboratory Notebooks, Logbooks, and Documentation
QA-110	Reagents
QA-111	Instrument and Equipment Calibration
QA-112	Instrument and Equipment Maintenance
QA-113	Data Entry, Verification, and Reporting of Results for the Computerized Sample Management System (CSMS)
QA-114	Data Storage, Security, and Archiving
QA-115	Quality Control Records
QA-116	Investigation and Corrective Action of Unacceptable Quality Control Data
QA-117	Personnel Training Records and Curriculum Vitae
QA-118	Quality Assurance Audits
QA-119	Proficiency Samples
QA-120	Documentation of Programming for the Sample Management System
QA-121	Quality Assurance Guidelines for Computers and Computerized Systems
QA-122	Investigation and Corrective Action Reporting for Laboratory Problems
QA-123	Missed Holding Time Reports
QA-124	External Audits
QA-125	Document Control
QA-126	Qualification and Validation Documentation for Laboratory Instrumentation and Equipment
QA-127	Handling of Client Technical Complaints (Investigations and Response)
QA-128	Compliance with Good Laboratory Practice (GLP) Regulations

6. Sampling Procedures

In order for meaningful analytical data to be produced, the samples analyzed must be representative of the system from which they are drawn. It is the responsibility of the client to ensure that the samples are collected according to accepted or standard sampling methods.

The laboratory will provide the appropriate sample containers, required preservative, chain-of-custody forms, shipping containers, labels, and seals. The majority of sample containers are purchased precleaned by the supplier. Any reused bottles are cleaned in-house following laboratory standard operating procedures. Special containers with traceability documentation are available upon request. Because the laboratory does not stock this type of container, 1 month prior notice is required.

Each lot of preservative will be documented and checked for contaminants before use. The appropriate bottle will be preserved with the new preservative and filled with deionized water to represent a sample. A similar container (that does not contain preservative) will be filled with deionized water to be used as a blank check. Analysis results are documented for each preservative lot number.

Trip blanks will be prepared by the laboratory and accompany sample containers at the project required frequency. Analyte free water will also be provided for field blanks.

A list of containers, preservatives, and holding times follows in Table 6-1.

Table 6-1				
Sample Containers, Preservatives, and Holding Times for Aqueous and Solid Samples				
Fraction	Vol. Req. (mL) Wt. Req. (g)	Container P=Plastic G=Glass	Preservation ^a	Holding Time ^d From Date of Collection
				Water Soil
Volatiles	3 x 40 mL	G	Cool, 4°C, pH <2 w/HCl, no headspace	14
	4 oz. jar	G	Cool, 4°C, no headspace	Days
	40-mL vial		Methanol	14
Pesticides/PCBs	<u>2 x 1000 mL</u> 100 g	G	Cool, 4°C ^b	7 14 Days to extraction ^c
Herbicides	<u>2 x 1000 mL</u> 100 g	G	Cool, 4°C ^b	7 14 Days to extraction ^c
Semivolatiles (Acid/Base Neutrals) includes PAH-SIM	<u>2 x 1000 mL</u> 100 g	G	Cool, 4°C ^b	7 14 Days to extraction ^c
Metals	<u>1000 mL</u> 100 g	P, G	HNO ₃ to pH <2	6 6 Months Hg 28 days
Sulfide	<u>500 mL</u> 100 g	G	Cool, 4°C (NaOH, ZnAC Waters Only)	7 7 Days
TPH-GRO	<u>3 x 40 mL</u> 100 g	G	Cool, 4°C pH <2 w/ HCl, no headspace	14 14 Days to extraction ^c
TPH-DRO	<u>2 x 1000 mL</u> 200 g	G amber	Cool, 4°C <2 with HCl	7 14 Days to extraction ^c
TOX	<u>4 x 250 mL</u> 50 g	G	Cool, 4°C H ₂ SO ₄ to pH <2, Na ₂ SO ₃	28 N/A Days
TOC	<u>125 mL</u> 20 g	G	Cool, 4°C H ₂ SO ₄ to pH <2	28 28 Days
COD	100 mL	P, G	Cool, 4°C, H ₂ SO ₄ to pH <2	28 Days
Sulfate	100 mL	P, G	Cool, 4°C	28 Days
Nitrate	2 x 40 mL	G	Cool, 4°C	2 Days
Nitrite	2 x 40 mL	G	Cool, 4°C H ₂ SO ₄ to pH <2	2 Days

Table 6-1				
Sample Containers, Preservatives, and Holding Times for Aqueous and Solid Samples				
Fraction	Vol. Req. (mL) Wt. Req. (g)	Container P=Plastic G=Glass	Preservation ^a	Holding Time ^d From Date of Collection
				Water Soil
Ammonia	50 mL	P,G	Cool, 4°C, H ₂ SO ₄ , to pH <2	28 Days
TSS	500 mL	P,G	Cool, 4°C, H ₂ SO ₄	7 Days
TDS	500 mL	P,G	Cool, 4°C	7 Days
Alkalinity	200 mL	P,G	Cool, 4°C	14 Days
TKN	500 mL	P,G	Cool, 4°C	28 Days
Hardness	100 mL	P,G	Cool, 4°C, HNO ₃ to pH <2	180 Days
Orthophosphate	100 mL	P,G	Cool, 4°C	48 Hours
Chloride	500 mL	P,G	Cool, 4°C	28 Days
Cation Exchange Capacity	100 g	G	Cool, 4°C	NA
Eh	<u>50 mL</u> 50 g	G	Cool, 4°C	Analyze Immediately NA
pH	<u>50 mL</u> 50 g	G	Cool, 4°C	Analyze Immediately NA
VOAs (524.2)	4 x 40 mL	G	Cool, 4°C, HCl to pH <2 ascorbic acid	14 Days
Silica	200 mL	P	Cool, 4°C	28 Days
Carbon Dioxide	2 x 40 mL	G	Cool, 4°C, no headspace	NA
Ignitability	<u>200 mL</u> 50 g	G	NA	30 NA Days
Corrosivity	<u>50 mL</u> 50 g	G	NA	Analyze Immediately 48 Hours
Reactivity	100 g	G	Cool, 4°C	NA NA
Moisture	50 g	G	Cool, 4°C	NA
Methane, Ethane, Ethene	2 x 40 mL	G	Cool, 4°C, HCl to pH <2, no headspace	14 Days

Table 6-1					
Sample Containers, Preservatives, and Holding Times for Aqueous and Solid Samples					
Fraction	Vol. Req. (mL) Wt. Req. (g)	Container P=Plastic G=Glass	Preservation ^a	Holding Time ^d From Date of Collection	
				Water	Soil
Acid Volatile sulfides, simultaneous extracted metals (AVS/SEM)	500 mL	G	Cool, 4°C, NaOH to pH >12	14 Days	NA

^apH Adjustment with acid/base is performed on water samples only.

^bSodium thiosulfate needed for chlorinated water samples

^cDue to the inaccurate recovery of 2-chloroethyl vinyl ether in the presence of HCl, Halocarbon samples analyzed for this compound should not be preserved.

^dSamples will be analyzed as soon as possible after collection. The times listed are the maximum times that samples will be held before analysis and still be considered valid.

^eAnalysis 40 days from extraction.

NOTE: For volatiles analysis, the container should be filled completely, with no headspace. All sample containers, preservatives, and mailers will be supplied at no additional charge upon request, except for the special containers with traceability documentation. There is an additional charge for this type of container.

7. Sample Custody

Samples are unpacked and inspected in the sample receipt area. At this time, the samples are examined for breakage and agreement with the associated client paperwork. The cooler temperatures will be checked upon receipt and recorded. As the samples are unpacked, the sample label information will be compared to the chain-of-custody record and any discrepancies or missing information will be documented. If necessary, the cooler will be closed and placed in cold storage until instructions and resolution of any discrepancies are received from the client.

A member of our Sample Administration Group will act as sample custodian for the project. To ensure accountability of our results, a unique identification number is assigned to each sample as soon as possible after receipt at the laboratory. When samples requiring preservation by either acid or base are received at the laboratory, the pH will be measured and documented, with the exception of samples designated for volatile analysis. Samples requiring refrigeration will be stored in our walk-in cooler which is maintained at 2° to 4°C. The use of our computer system in tracking samples (by the Lancaster Labs sample number assignment) will control custody of the sample from receipt until the time of its disposal. The security system on our laboratory building allows us to designate the entire facility as a secure area since all exterior doors are either locked or attended. Therefore, hand-to-hand chain of custody is not part of our routine procedure, but is available upon request. If requested, hand-to-hand chain of custody will be provided as per attached SOP-QA-104, "Chain-of-Custody Documentation." The laboratory chain of custody will begin with the preparation of bottles. The procedures for sample log-in, storage, and chain-of-custody documentation are detailed in the QA standard operating procedures included in Section No. 7 (SOP-QA-102, SOP-QA-103, and SOP-QA-104). Examples of sample labels and a custody seal are shown in Figure 7.1.

QUALITY ASSURANCE MANUAL

Revision 8.0

BROS Phase 2
Recipient ID: RI/FS QAPP

Document ID: QA8002

Prepared by:
Safety-Kleen (ENCOTEC), Inc.

NOTICE

This document accurately presents the quality assurance philosophy and capabilities of Safety-Kleen (ENCOTEC), Inc. as of the date of publication. This document is reviewed on an annual frequency; revisions to any or all sections may occur as a result.

This manual, or any part thereof, is not intended for use without the expressed, written consent of Safety-Kleen (ENCOTEC). Any liability associated with its unauthorized use rests solely with the user.

ENCOTEC

QUALITY ASSURANCE MANUAL Rev. 8.0

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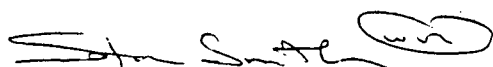
8/03/98
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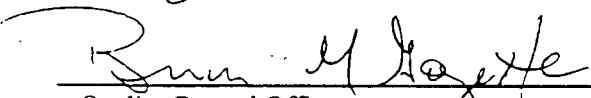
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LIST OF ACRONYMS
(in order of appearance)

QA	Quality Assurance
QC	Quality Control
ASTM	American Society for Testing and Materials
LIMS	Laboratory Information Management System
IS	Information Systems
LAN	Local Area Network
QAG	Quality Assurance Group
QCO	Quality Control Officer
ISO	International Standards Organization
DQO	Data Quality Objective
GC/MS	Gas Chromatography/Mass Spectroscopy
GC/HPLC	Gas Chromatography/High Pressure Liquid Chromatography
TCLP	Toxicity Characteristic Leaching Procedure
ICP	Inductively Coupled Plasma
ICP/MS	Inductively Coupled Plasma/Mass Spectroscopy
GFAA	Graphite Furnace Atomic Absorption
CVAA	Cold Vapor Atomic Absorption
AA	Atomic Absorption
TDO	Technical Documentation Officer
QAPP	Quality Assurance Project Plan
PE	Performance Evaluation
QAM	Quality Assurance Manual
SOP	Standard Operating Procedure
MDL	Method Detection Limit
IDPA	Initial Demonstration of Precision and Accuracy
SSP	Standard Safety Procedure
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
SARA	Superfund Amendments and Reauthorization Act
CLP	Contract Laboratory Program
SOW	Statement of Work
RCRA	Resource Conservation and Recovery Act
CWA	Clean Water Act
NPDES	National Pollution Discharge
SDWA	Safe Drinking Water Act
CAA	Clean Air Act
OSHA	Occupational Safety and Health Administration
MSDS	Material Safety Data Sheet
HLSDL	High Level Sample Disposal Log

LIST OF ACRONYMS (con't.)

%RSD	Percent Relative Standard Deviation
ICV	Initial Calibration Verification
CCV	Continuing Calibration Verification
SPCC	System Performance Check Compound
CCC	Calibration Check Compound
CCB	Continuing Calibration Blank
NIST	National Institute for Standards and Technology
ACS	American Chemical Society
HSWA	Hazardous and Solid Waste Amendments to RCRA
EDD	Electronic Data Deliverables
RPD	Relative Percent Difference
WP	Water Pollution
WS	Water Supply
EMSL	Environmental Monitoring Support Laboratory
A2LA	American Association for Laboratory Accreditation
QIR	Quality Investigation Reports
ERA	Environmental Resource Associates

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LIST OF SEPARATE APPENDICES TO THIS DOCUMENT

Appendix I State of Ohio Voluntary Action Program (VAP)

1.0 ENCOTEC - SCOPE OF SERVICES AND FACILITIES

1.1 Scope of Services

Safety-Kleen (ENCOTEC), Inc. (hereafter referred to as ENCOTEC), a wholly owned subsidiary of Safety-Kleen Corp., has provided comprehensive environmental consulting and analytical services since 1969. The firm has performed long-term, large scale investigations and surveys involving hazardous waste, hazardous waste sites, and environmental monitoring for both public agencies and private sector clients. The distinguishing feature of the company is the capability to determine the field monitoring program(s) needed to investigate an environmental problem, collect uncontaminated representative samples, perform the laboratory analyses, and then evaluate the data.

ENCOTEC, located in Ann Arbor, Michigan, currently houses its operations in two nearly adjacent modern facilities totaling 44,000 square feet.

1.2 Facilities

In many ways, a well-engineered and designed laboratory can be a very influential factor in the production of high quality data but it is often an overlooked element in a properly functioning Quality Assurance/Quality Control (QA/QC) program. ENCOTEC has carefully allocated space for employees, instrumentation, and support services. Instrumentation has been chosen by matching applications to the regulation and/or a client's analytical request. Instrumentation must meet or exceed specific quality control criteria before it can be used in the generation of data.

1.3 Space Allocation and Design Criteria

ENCOTEC has identified the following important criteria for the determination of space allocation and design of the laboratories.

1.3.1 Adequate Floor Space

ENCOTEC provides over 15,600 square feet of floor space devoted to a variety of laboratory applications. It is very important to ensure that analysts work in an environment that is not over-crowded and that analysts have adequate space to perform their tasks.

1.3.2 Adequate Bench Space

This criterion can be evaluated with respect to the maximum number of analysts using any given laboratory. ENCOTEC guidelines are that every analyst on a given shift should have a minimum of 10 feet of linear bench space available to perform his/her work.

1.3.3 Adequate Hood Space

ENCOTEC has dedicated significant amounts of bench space to fume hoods for operations which require negative pressure (e.g., use of acids/solvents, preparing hazardous or potentially hazardous samples, or testing which evolves dangerous vapors/gases). ENCOTEC maintains approximately 220 linear feet of hood space. Most hoods are fitted with make-up air duct systems which supply fresh air from outside the building. Areas of high hood usage are under negative pressure.

1.3.4 Air Flow Balance

Laboratories which perform volatiles analysis should be under positive pressure to ensure that the diffusion of common laboratory solvents such as methylene chloride into those laboratories is minimized. All areas where solvent usage is high should be under negative pressure. ENCOTEC laboratories have been designed with this requirement in mind.

1.3.5 Adequate Power Requirements

A significant amount of time has been devoted to determining and meeting electrical power requirements in the laboratories. The result is a system involving four major circuit types, supplying ample power to all laboratories. A 110V circuit for general use, identified by white outlets, is available to all areas of the building. A separate set of "clean" 110V circuits, indicated by orange outlets, is provided for use with computer-aided instruments/equipment. Single receptacle 110V circuits dedicated to analytical instrumentation are marked by brown outlets. Finally, all 220V single receptacle circuits dedicated to analytical instrumentation are distinguished by "twist lock" outlets.

1.3.6 High Purity Water

All laboratories are equipped with taps dispensing deionized (i.e., ASTM Type II) and Super Quality® (i.e., ASTM Type I) water. These convenience taps ensure that all analysts have ready access to ample water of the purities specified for glassware washing and rinsing and for analytical use.

1.3.7 Clean Environment

ENCOTEC operates on a philosophy of "a clean laboratory will help to ensure quality." This cleanliness is important to reduce the potential for laboratory contamination. Dust removal is important in the maintenance of computer equipment. ENCOTEC has implemented a variety of management and design controls to ensure clean laboratories.

1.3.8 High Hazards Areas

ENCOTEC maintains isolated areas for work with hazardous or potentially hazardous materials. Glove boxes and adequate hood space are integral to health threat minimization.

1.3.9 Information Access

Laboratory and office area computers are networked with a ratio of computers to staff of approximately one to one. All laboratories and ancillary services have access to the Laboratory Information Management System (LIMS). Readily available sample information facilitates proper scheduling and helps to ensure that analyses are performed within holding times. Local networks within some laboratories are used to generate and archive raw data such as chromatography files, spectra, quantitation reports, etc. The LIMS is maintained by the Information Services (IS) staff and sample information is archived on a regular basis.

1.3.10 Data Review Areas

ENCOTEC has dedicated significant amounts of space to "quiet areas" for data review. These areas are equipped with computer stations for data handling. All applicable SOPs and reference materials are available.

The following blueprint facsimiles (Figures 1.1 through 1.3) are provided to detail the laboratory facility design and are referenced by Table 1.1 for information regarding area, linear bench space, and linear hood space.

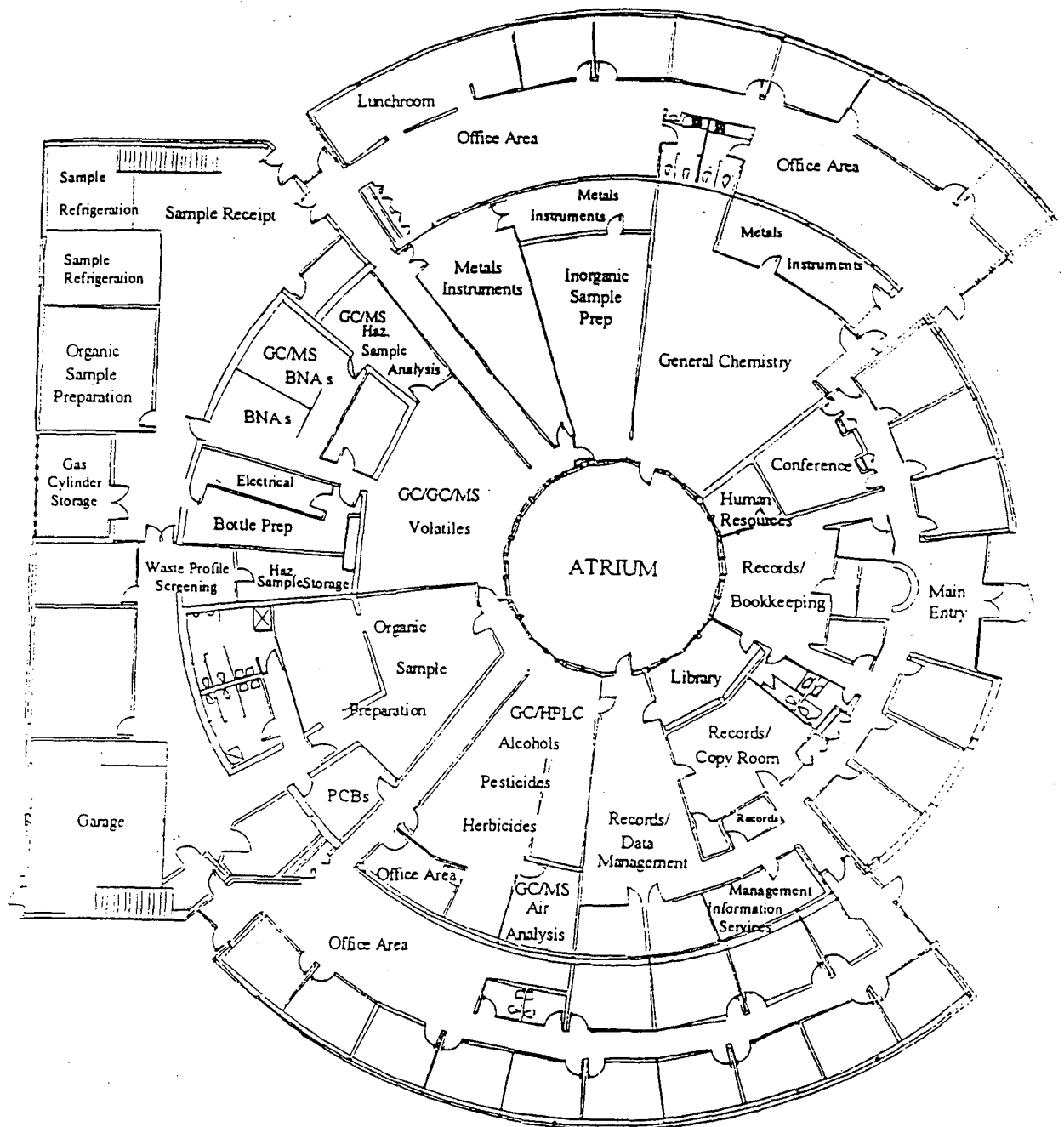


Figure 1.1: ENCOTEC I, Main Floor

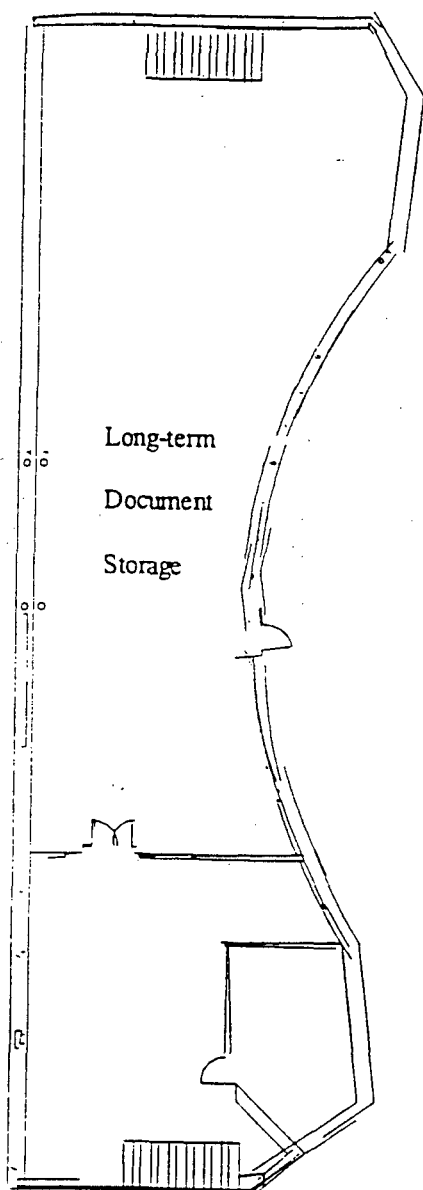


Figure 1.2: ENCOTEC I, Second Floor

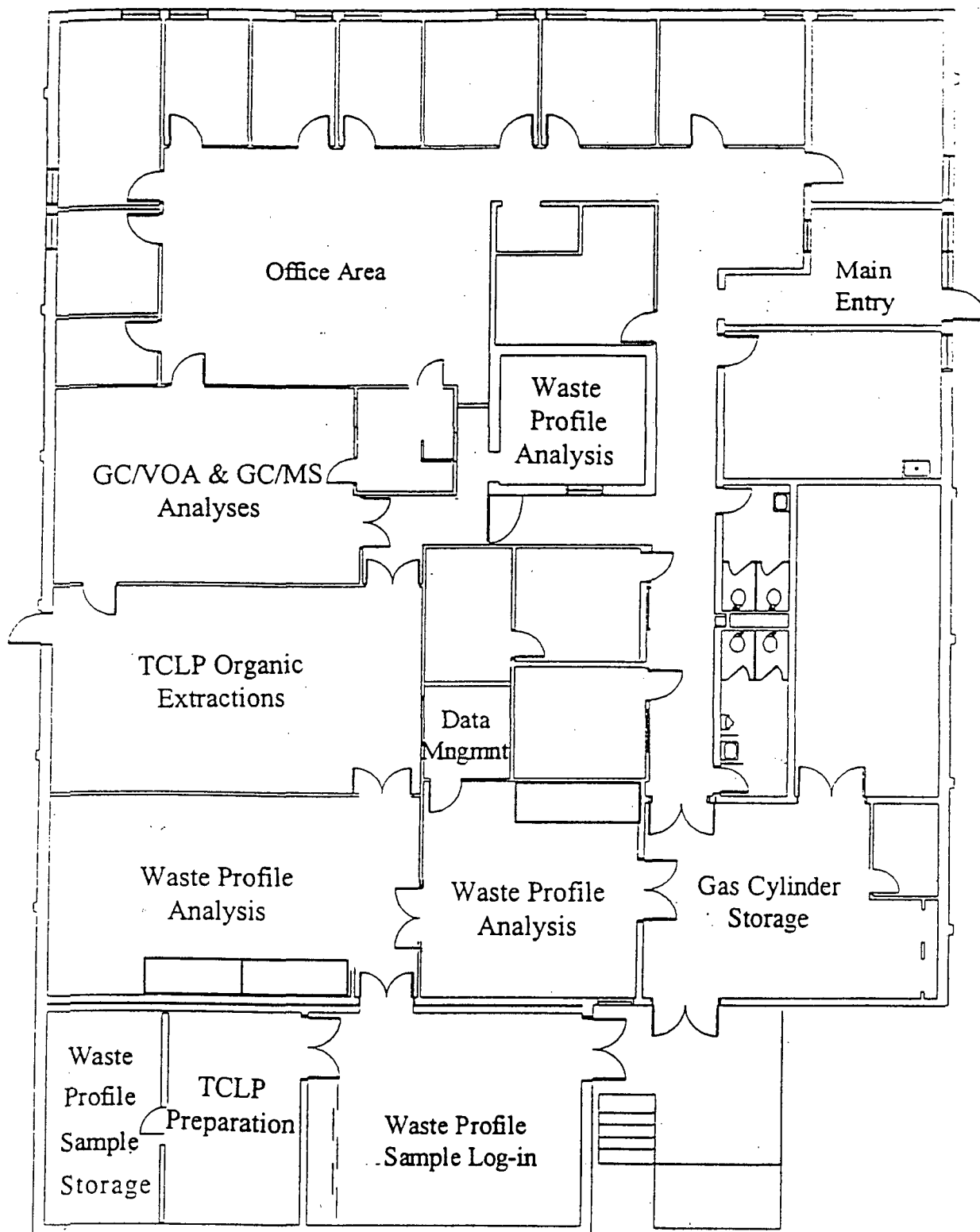


Figure 1.3: ENCOTEC II

TABLE 1.1
FACILITY SPACE ALLOCATION

Laboratory Description	Est. Area (sq. ft.)	Bench Space (lin. ft.)	Hood Space (lin. ft.)
ENCOTEC I, 3985 Research Park Drive			
Data Review Area	750	N/A	N/A
General Chemistry Laboratory	1035	130	12
Inorganic Sample Prep Laboratory	630	50	12
Metals Instruments Laboratory	1400	53	0*
GC/MS Haz. Sample Analysis	250	21	6
GC/GC/MS Volatiles Laboratory	1120	59	0
GC/MS Air Analysis Laboratory	400	38	0
GC/MS BNAs Laboratories	620	31	0
Organic Sample Preparation Laboratories	940	118	84
PCBs Laboratory	290	46	4
GC/HPLC Laboratory: Alcohols, Pesticides, Herbicides	960	88	12
Sample Receipt (Laboratory Support Group)	400	40	4
Sample Refrigeration	200	N/A	N/A
Sample Refrigeration	200	N/A	N/A
Waste Profile Screening & Haz. Sample Storage	130	10	4
Gas Cylinder Storage Pad	270	N/A	N/A
Bottle Prep Laboratory	250	28	6
Office and Support Areas	25155	N/A	N/A
ENCOTEC II, 3965 Research Park Drive			
Data Mngmnt	100	N/A	N/A
Waste Profile General Chemistry & Metals Analysis Laboratories	1120	93	38
Organic Sample Preparation Laboratory	150	24	0
Organic Sample Preparation Laboratory	735	69	20
GC Volatiles Analysis Laboratory	520	58	11
Waste Profile Sample Log-in	2600	19	5
Waste Profile Sample Storage Area	100	N/A	N/A
Office and Support Areas	3675	N/A	N/A
Total Laboratory	15170	975	218

* Venting provided for instrument exhaust gases not included as available hoodspace.

2.0 ORGANIZATION AND RESPONSIBILITY

2.1 ENCOTEC Organization

See figure 2.1. A summary of each area's major activities as they pertain to ENCOTEC's quality assurance program follows.

2.1.1 Laboratory Operations

- Ensures that approved analytical procedures are used and that the associated quality control criteria of the method are met; appropriate corrective action in response to excursions to those criteria is taken in a timely manner.
- Coordinates the proper implementation of QC procedures and analytical methods within the laboratories.
- Evaluates and co-approves capital equipment expenditures and facility improvements to respond to operational needs.
- Balances client needs with individual department staff and technical capacities in order to minimize work overloads. Work overloads may have an adverse effect on data quality.

2.1.2 Client, Sample Receipt, and Field Services

- Client Services begins with understanding a client's needs prior to the initiation of any analytical work. This aids in the identification of the correct analytical procedures to use, identifies the client's data quality objectives, ensures that their needs are compatible with laboratory capabilities, and may provide the laboratory with site or sample matrix information which may enhance the quality of the final analytical result.
- Facilitates the timely scheduling and receipt of analytical work, thereby reducing the occurrence of work overloads which, in turn, could affect data quality.
- Through the Laboratory Support Group, provides control of samples delivered for analysis, from arrival to sample disposal. Also provides properly prepared sample containers for use by either clients' sampling personnel or ENCOTEC's Field Services Group.
- Through the Field Services Group, conducts field sampling in support of analytical activities.
- Evaluates analytical data submitted by laboratories based upon site history (if known) and provides necessary feedback to the laboratories regarding the quality of that correlated data.
- Provides final review of data for reasonableness, overall accuracy, and correlation of results, and transmits the approved data package to the client.

- Facilitates the review of proposed contracts through the distribution of these document(s) to Laboratory Operations and the Quality Assurance Group (QAG) and/or other key personnel as appropriate. Significant findings from the review will be communicated to the client in order to clarify contract specifications. Prior to accepting the work, modifications to the contract may be needed in order to arrive at a contract consistent with ENCOTEC's capabilities and quality program. Contracts and contract review records are appropriately archived.
- Arranges for any needed subcontracted analytical services from a laboratory that meets ENCOTEC's procurement specifications for subcontractors.
- Communicates (any) amendments to contracts to Laboratory Operations. Amendments are typically communicated to the laboratories through the Laboratory Support Group. Certain amendments may require prior approval by Laboratory Operations and/or the QAG.
- Acts as the primary ENCOTEC point of contact for issues arising from client feedback.

2.1.3 Quality Assurance Group

- Provides QA/QC oversight, monitoring of existing programs through internal audits, and ongoing QA program development to ensure their compliance with International Standards Organization (ISO) 9002 and ISO 25 requirements.
- Provides coordinated oversight with Laboratory Operations in analytical methods development.

- Oversees any modification to existing procedures through the control and approval of standard operating procedures, procedural memoranda, and related forms.
- Issues reports to management regarding the quality of services.
- Monitors significant findings resulting from customer feedback and/or audits as part of the corrective action process.
- Evaluates and approves subcontractors on the basis of their ability to meet ENCOTEC's quality requirements specific to the services subcontracted; maintains records of subcontractor qualifications.
- Maintains existing laboratory certifications and pursues new ones in response to regulatory requirements and business needs.
- Provides technical review of proposed contracts to ensure that the laboratory's capabilities are compatible with the project's Data Quality Objectives (DQO) and (any) related contractual requirements.

2.1.4 Business Development

- Identifies new business opportunities which are compatible with the quality assurance and analytical capabilities provided by ENCOTEC.

2.1.5 Information Systems

- Maintains the Local Area Network (LAN) and develops related Good Automated Laboratory Practices.
- Is responsible for the implementation and ongoing development of the LIMS.
- Provides software and computer systems support to all departments.

2.1.6 Accounting

- Maintains records and purchasing documents of all vendors from whom supplies are needed in support of analytical services rendered; vendors are pre-approved.
- Approves capital equipment expenditures and facility improvements to respond to operational needs.
- Overall, adheres to company policies regarding the procurement of supplies.

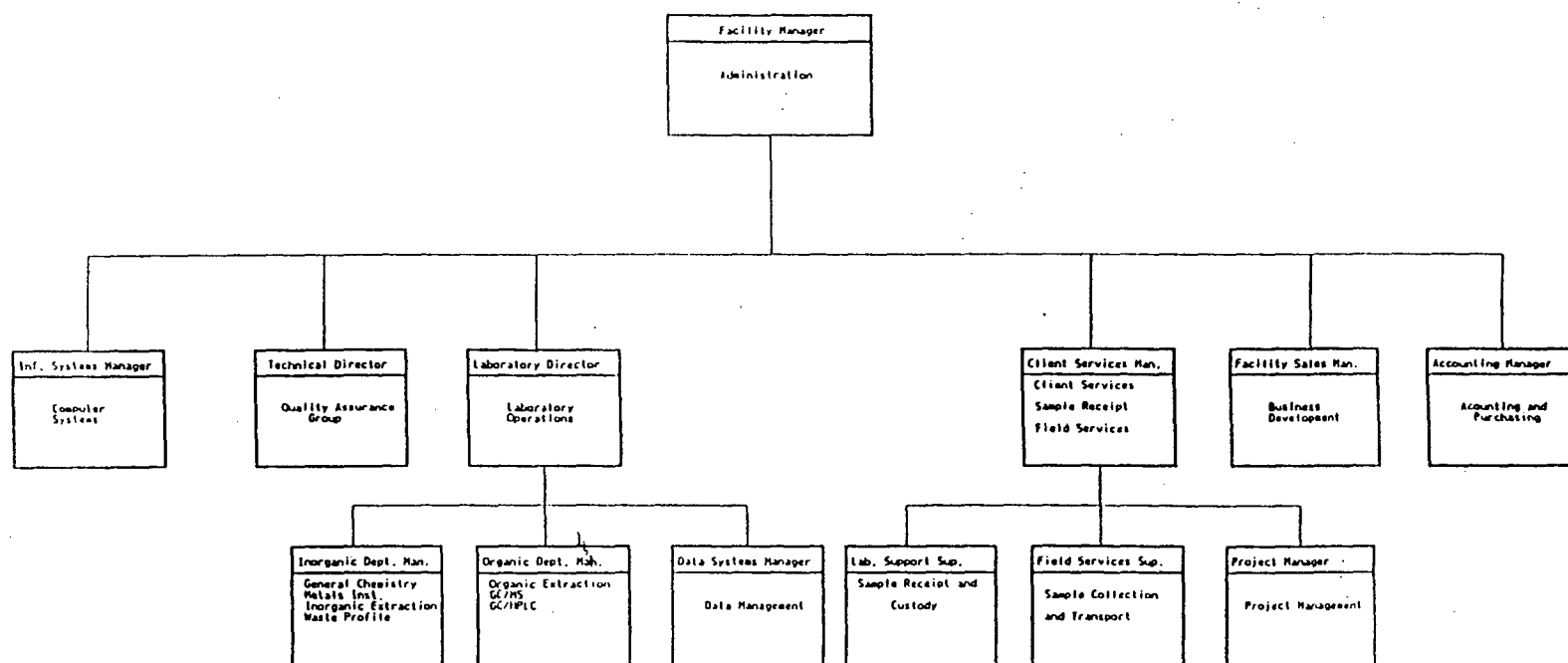


Figure 2.1: ENCOTEC Organization

2.2 Laboratory Operations Management Structure

See figure 2.2. Two department managers, who report to the Laboratory Director, oversee laboratory operations in the Inorganic and Organic Laboratories. Group leaders and supervisors comprise the next management level. A brief description of each laboratory/area follows.

2.2.1 Organic Laboratories

- Organic Extractions performs sample extraction for semivolatile compounds in water, soil, and air by EPA approved methods.
- GC/MS conducts analysis of volatile and semivolatile compounds in water, soil, and waste using EPA approved gas chromatography and gas chromatography/mass spectroscopy methods.
- GC/HPLC conducts analysis of semivolatile compounds in water, soil, and waste and volatile compounds in air, using EPA approved gas chromatography/selective detector methods.

2.2.2 Inorganic Laboratories

- Inorganic Extractions - performs sample preparation for the Metals Laboratory and TCLP extraction for both Metals and applicable laboratories in the Organics Department.

- Metals conducts analysis for metallic analytes in water, soil, waste, and particulates in air by Inductively Coupled Plasma (ICP), ICP/MS, GFAA, CVAA, and/or Hydride-AA using EPA approved methods.
- General Chemistry conducts analysis for general chemistry parameters in water, soil, waste, and particulates in air, using EPA approved methods and Standard Methods.

2.2.3 Waste Profile Laboratories

- Waste Profile conducts analysis on (potentially) hazardous waste samples based on EPA approved and ASTM methods. Also performs TCLP extraction for both Metals and applicable laboratories in the Organics Department.

2.2.4 Data Systems

- Data Systems is responsible for the secondary review of analytical results generated by the laboratories, review of associated QC results, data summary, delivery of summarized data to the project manager, and archiving of raw data packages.
- The group is also responsible for maintaining the data archive, including effective procedures for long-term storage and efficient retrieval. (Records archival practices at ENCOTEC stipulate that raw data must be archived for three years (standard) after generation.)

2.2.5 Client Services

- Project Managers serve as the first point of contact for clients with established contracts or other work orders. They are responsible for supervising the progress of clients' work from the arrival of samples through the delivery of the results of analysis and the disposal of the analyzed samples.

2.2.6 Sample Receipt

- The Laboratory Support Group (LSG) provides the proper preservation/storage, receipt, and disposal of samples received for analysis by the laboratory and initiates a chain of custody for every sample received. This group works with project managers in assigning the correct analytical procedures to each sample and in communicating this information to all appropriate laboratories.
- The LSG also communicates with laboratories and project managers such sample receipt information as the sampling date for holding time determination, method(s) of analysis, preservation requirements, data deliverables type (ENCOTEC QC level), etc.

2.2.7 Field Services

- When ENCOTEC and a client have agreed that ENCOTEC will collect samples as well as analyze them, the Field Services group performs the collection activities.

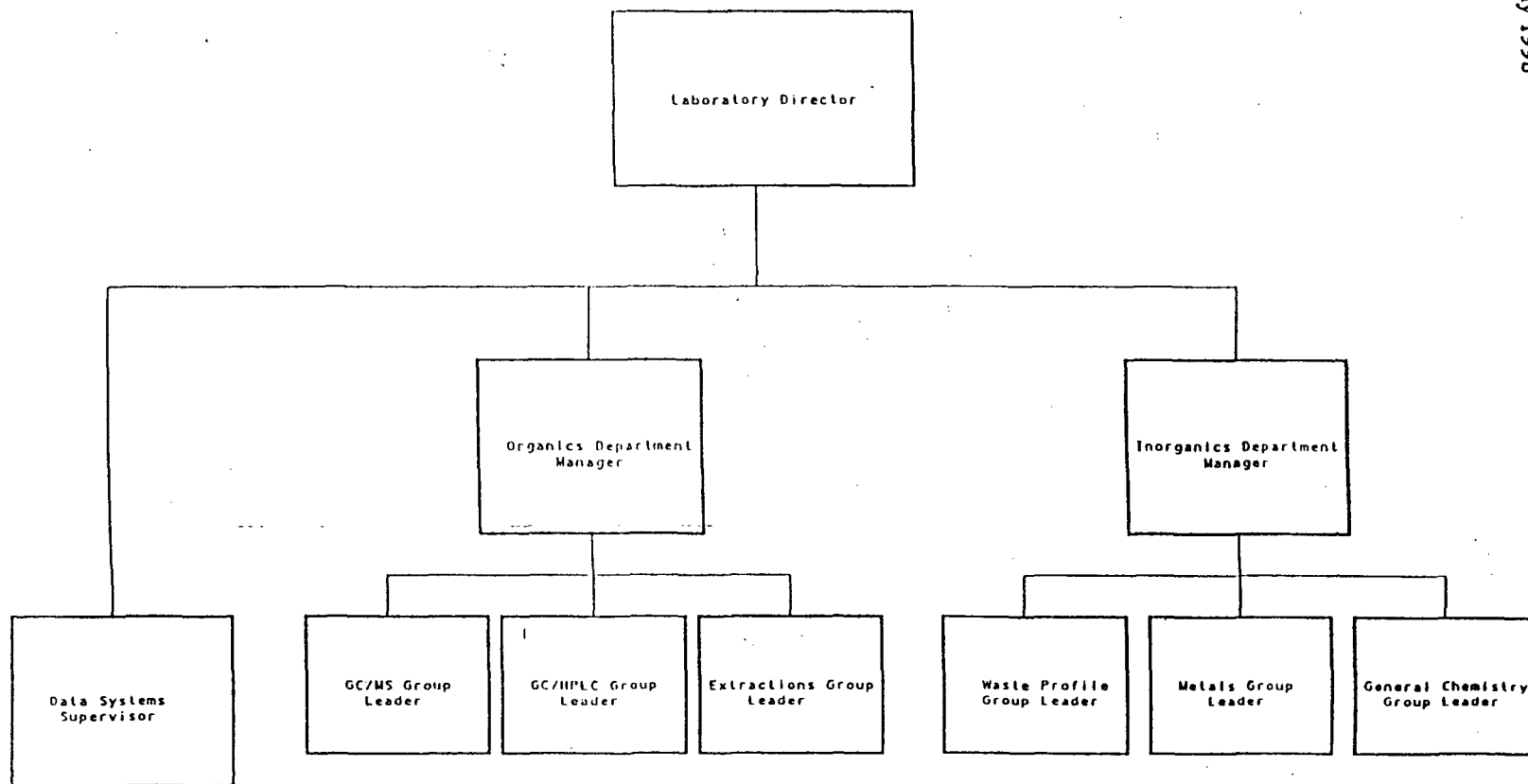


Figure 2.2: Laboratory Operations Management Structure

2.3 Quality Assurance Group Interface

See figure 2.3. This chart illustrates the lines of communication between the Quality Assurance Group, Facility Manager, Laboratory Operations Director, Information Systems Director, and Client Services Managers. The Quality Assurance Group is comprised of the Technical Director, Quality Control Officer, Technical Documentation Officer (TDO), and Environmental Compliance/Health and Safety Officer, with the Technical Director reporting to the Facility Manager.

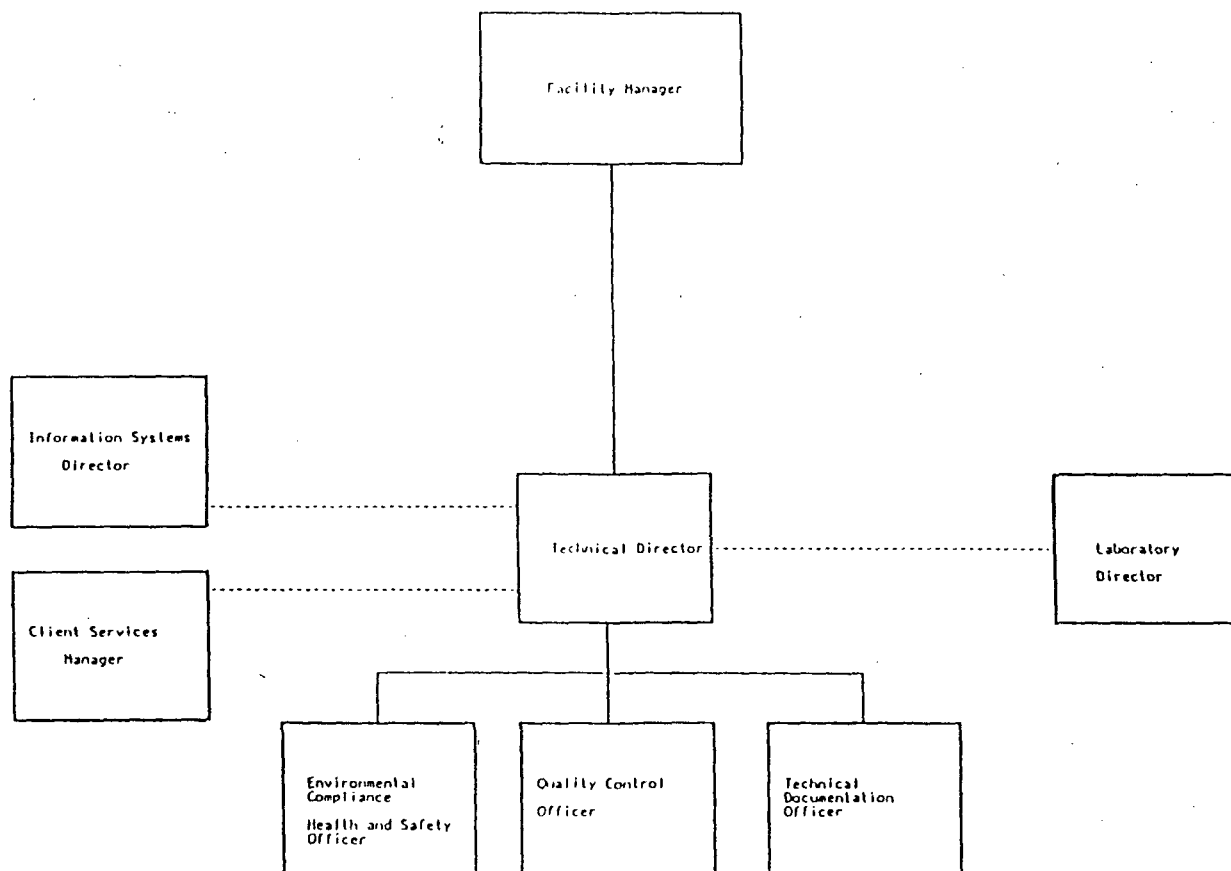


Figure 2.3: Quality Assurance Group Interface

2.4.2 Laboratory Director

- Overall responsibility for laboratory operations.
- Interfaces frequently with the Technical Director regarding activities within these groups which involve the quality of analytical services.
- Implements changes in laboratory and Data Systems groups as a result of approved modifications to ENCOTEC's quality program.
- Designates responsible individuals in the event of his/her absence. Activities contained within Laboratory Operations will generally be the responsibility of the designated department manager or the laboratory group leader as appropriate. Responsibilities which reach outside these groups will generally be assumed by the Facility Manager (or his/her delegate) as appropriate.

2.4.3 Information Systems Director

- Overall responsibility for the Information Systems group.
- Interfaces with the Technical Director regarding activities within this group which involve the quality of analytical services.
- Implements changes in this group as a result of approved modifications to ENCOTEC's quality program.

- Designates responsible individuals in the event of his/her absence. Activities governed by Information Systems will generally be the responsibility of the staff as appropriate. Responsibilities which reach outside these groups will generally be assumed by the Facility Manager (or his/her delegate) as appropriate.

2.4.4 Technical Director

- Provides overall direction to ENCOTEC's Quality Assurance program to ensure that it is implemented and maintained in accordance with ANSI/ASQC 09002 (ISO 9002)-1994 and ISO/IEC Guide 25-1990 quality standards; acts as management's representative for that program.
- Identifies and coordinates the development of quality policies and procedures and/or initiates revision to existing ones if needed.
- Advises chemistry staff of EPA approved changes in existing procedures and of proposed methodologies. Works with Laboratory Operations management in the improvement of existing analytical methods and in the identification of new analytical applications. New methods (promulgated by the EPA) or information on proposed analytical methods are disseminated to the laboratories. (Prior to implementation, revised procedures must be approved.) Evaluates projects requiring special analytical methods or techniques for feasibility.
- Works to expand certification for the laboratories under various state and federal programs and advises the company of state and federal agency quality assurance and quality control policy developments. Maintains existing certifications with inquiry and application into new certification

programs on an as needed basis..

- Provides review of Quality Assurance Project Plans (QAPPs), Requests for Proposal, etc. for consistency with ENCOTEC's QA program and compatibility with analytical capabilities.
- Coordinates and maintains records associated with the periodic executive management review of ENCOTEC's quality system performed to ensure its continuing suitability and effectiveness.
- Exercises final approval of revisions to the Quality Assurance Manual.
- Designates responsible individuals in the event of his/her absence. Activities within the purview of the QAG will be the responsibility of the QCO or TDO, as appropriate. Responsibilities which reach outside this group will generally be assumed by the Facility Manager or Laboratory Director.

2.4.5 Department Managers

- Responsible for laboratory operations in the Inorganic, Organic, or Waste Profile laboratories.
- Interface frequently with the Technical Director, Chemistry Business Director, and the Laboratory Director regarding activities within their respective groups which involve the quality of analytical services.

- With oversight by the Laboratory Director, implement changes in these groups as a result of approved modifications to ENCOTEC's quality program.

2.4.6 Client Services Managers

- Proper communication between the Client Services Manager/Project Manager and the client facilitates the timely scheduling of analytical work. Work overloads or scheduling conflicts are reduced, limiting any effect on data quality.
- Client Services Managers supervise the activities of the Laboratory Support Group and the Field Services Group.
- The Client Services Managers/Project Managers oversee the final review of summarized data following receipt from Data Systems. Review of the data occurs again for reasonableness based upon the project manager's knowledge of the investigation. Review against historical data may also be performed through prior arrangement with the client.
- Custom reports may be requested by the client through the Client Services Manager/Project Manager. *Non-routine reporting requirements or special analytical requests* are reviewed by the Laboratory Director, the Technical Director, the Information Systems Manager, the TDO, and the Client Services Manager/Project Manager.

- Laboratory group leaders and supervisors are responsible for the primary review of analytical results generated by the laboratories, review of associated QC results, data summary, delivery of summarized data to Data Systems.
- The Data Systems Supervisor oversees the secondary review of laboratory data for adherence to quality control criteria and is responsible for report form summary. ENCOTEC QC Level deliverables, assigned at sample log-in, are assembled. Reanalysis, if still needed, is requested at this point and approved by the group leader; the project manager is notified. Laboratory narratives, if requested, summarize any needed corrective actions and overall integrity of the data from the laboratory's perspective.
- Responsible for scheduling training activities for staff in accordance with ENCOTEC's training procedures and training matrix.
- Implements new/revised methods under the direction of operations and technical management. Verification that quality control criteria can be met must be established prior to full implementation of the method.

2.4.9 Technical Documentation Officer

- Primary responsibility for the writing, updating, distribution, control, and archiving of technical documents such as Standard Operating Procedures (SOPs), Procedural Memoranda, and forms.

- Maintains Method Detection Limit (MDL) study and Initial Demonstration of Precision and Accuracy (IDPA) files and initiates requests for annual MDL evaluations. MDL (or Instrument Detection Limits where applicable) and IDPA are determined per EPA procedures on an annual basis for all routine analyses. These determinations are scheduled in the laboratory and are then evaluated for consistency with reported quantitation limits or precision and accuracy criteria in the applicable method.
- Reviews and edits Field Services SOPs and Standard Safety Practices (SSP).
- Maintains staff training summary documentation. Training events may be either off-site through short courses, manufacturer's training courses, etc., or on-site. Available on-site training includes QA, initial, and group-specific training activities. Employee training records are monitored by the TDO. Formal education records are maintained by the Human Resources Coordinator.
- Reviews client reporting requirements for compatibility with existing laboratory capabilities. Potential problems are brought to the Technical Director's attention for resolution.
- Maintains control charts and evaluates control limit criteria; facilitates periodic changes in control limits (if needed). Quality Control Limits are established per the referenced EPA method or established internally. The TDO evaluates and approves control limits before implementation. Internally derived limits are determined by standard procedures modeled after EPA guidelines.

2.5 Safety-Kleen Corp. - Parent Company

Figure 2.4 illustrates the functional organization of the parent corporation, Safety-Kleen Corp. and ENCOTEC's position within that organization.

ENCOTEC, through its Facility Manager, reports to the Senior Vice-President of Central Services.

2.4.7 Quality Control Officer

- Responsible for Performance Evaluation (PE) programs including (any needed) corrective actions.
- Monitors laboratory quality control criteria and data package integrity through internal data validation of randomly selected data packages.
- Responsible for the monitoring of corrective actions needed under this QA program. (Actions needed in response to deficiencies cited through internal/external audits, performance evaluations, and internal audits are monitored. Implementation is verified through a follow-up assessment.)
- Conducts annual comprehensive internal laboratory audits.
- Participates in the review and update of the Quality Assurance Manual (QAM).

2.4.8 Laboratory Operations - Group Leaders, Supervisors

- Group leaders and supervisors are involved in the review of drafts of analytical procedures (i.e., Standard Operating Procedures) with the approval process following ENCOTEC document control procedures. Revisions to these procedures are requested by the Technical Documentation Officer (TDO) on a periodic basis with review and comment by laboratory operations.

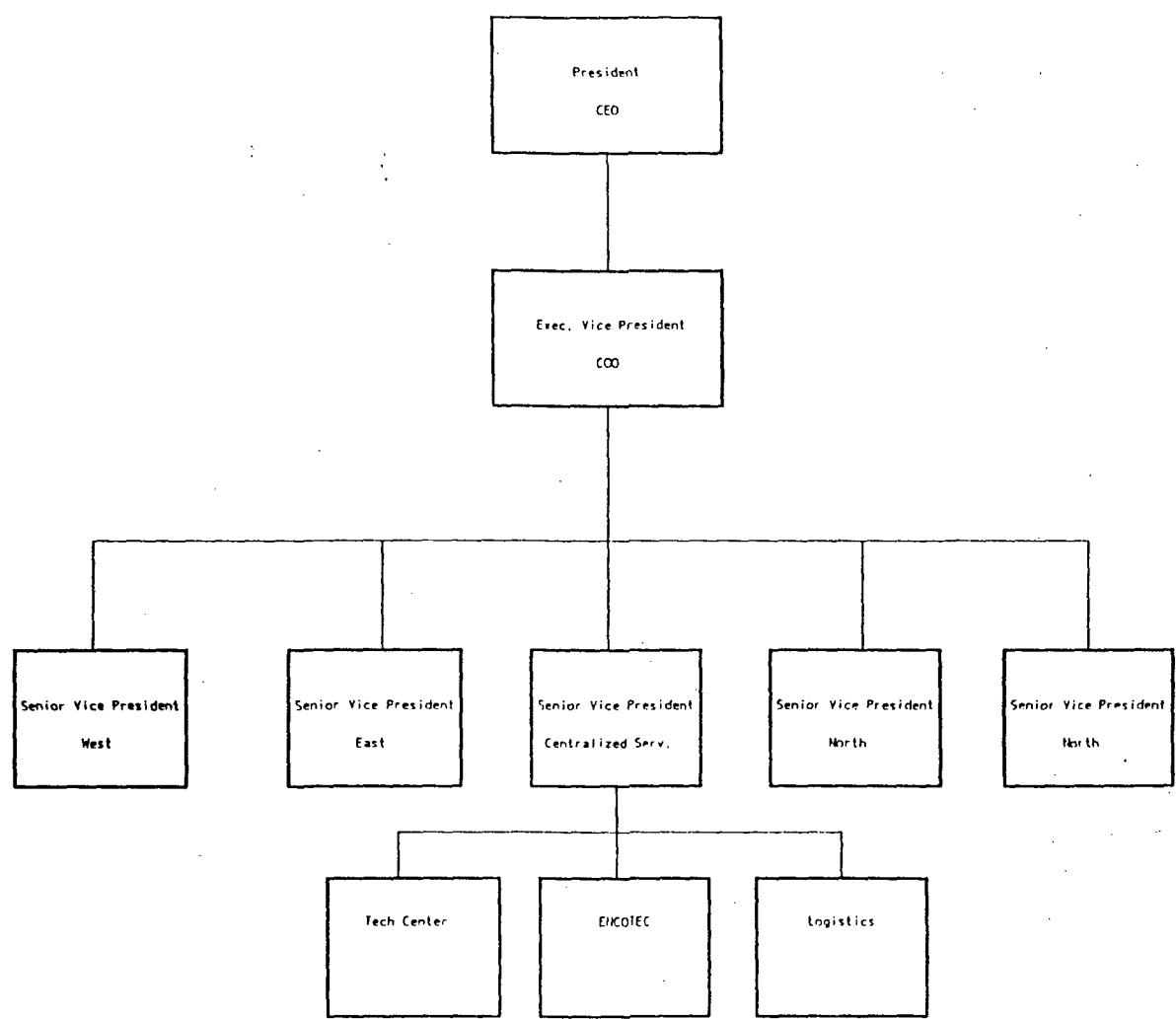


Figure 2.4: Safety-Kleen Corp. Organization

2.4 Responsibilities of Key Personnel

This section describes the responsibilities of key personnel as they pertain to ENCOTEC's QA program.

2.4.1 Facility Manager

- Executive responsibility for ENCOTEC's laboratory and quality assurance program.
- Oversees the periodic executive management review of ENCOTEC's quality program. These reviews will be conducted, at a minimum, on an annual frequency.
- Responsible for appointing a member of the management team (i.e., the Technical Director) who will ensure that the quality system is maintained in accordance with ISO 25 and 9002 quality standards.
- Interfaces frequently with the Technical Director regarding activities which involve the quality of analytical services.
- Directs that changes, determined as a result of approved modifications to ENCOTEC's quality program, take place.
- Designates responsible individuals in the event of his/her absence. Activities will be assigned to the Laboratory Director, the Information Systems Director, or the Technical Director as appropriate.

Bridgeport Rental and Oil Services (BROS)
Laboratory Quality Assurance Plan - On-site Analysis
Revision: 1
Date: 7-25-98

Laboratory Quality Assurance Plan

**On-site Laboratory Analysis in Support of Phase 2
Remediation Investigation and Feasibility Study (RI/FS)
at the Bridgeport Rental and Oil Services (BROS) NPL Site**

**July 1998
Revision : 1**

LABORATORY
QUALITY ASSURANCE PLAN

FOR

ONSITE LABORATORY ANALYSIS
IN SUPPORT OF THE REMEDIATION INVESTIGATION AND
FEASIBILITY STUDY AT THE BRIDGEPORT RENTAL AND
OIL SERVICES (BROS) NPL SITE

PREPARED
FOR

ROUX ASSOCIATES INC.

JULY 1998

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Revision: 1
Date: 7-25-98

ADDENDUM SUMMARY

<u>Addendum Number</u>	<u>Date</u>	<u>Comments</u>
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1. INTRODUCTION

ONSITE Environmental Laboratories, Inc. has been selected by ROUX ASSOCIATES to perform on-site laboratory analysis in support of with the remediation investigation and feasibility study of the Bridgeport Rental and Services (BROS) NPL Site.

1.1 PURPOSE OF THE LABORATORY QUALITY ASSURANCE PLAN

The purpose of the Laboratory Quality Assurance Plan (LQAP) is to outline the specific procedures for analytical activities during remediation of contaminated soils and groundwater quality. The LQAP functions as a written statement of the laboratories approach to ensure quality data will be generated.

1.2 DOCUMENT ORGANIZATION

This document has been organized into the following 15 sections:

<u>Section</u>	<u>Title</u>
1	Introduction
2	Chemical Data Quality Objectives
3	Project Organization and Responsibilities for Quality Control
4	Sample Handling and Chain-of-Custody Procedures
5	Sample Storage Packaging and Shipping
6	Quality Objectives for Measurement Data
7	Data Reduction, Validation, and Reporting
8	Calibration Procedures and Frequency
9	Internal Quality Control Checks
10	Performance and System Audits - On-site Laboratory
11	Preventive Maintenance - On-site Laboratory
12	Corrective Action Procedures
13	Procedures Used to Assess Data Quality
14	Quality Assurance Reports to Management- On-site Laboratory
15	Quality Assurance Plans

Bridgeport Rental and Oil Services (BROS)
Laboratory Quality Assurance Plan - On-site Analysis
Revision: 1
Date: 7-25-98

2. CHEMICAL DATA QUALITY OBJECTIVES

2.1 INTRODUCTION

The objective of the LQAP is to ensure the data quality from the on-site lab. USEPA definitive level data analysis and reports will be provided for analyses. Summaries of the sampling and analytical procedures for the on-site laboratories are presented in Tables 2-1 and 2-2, respectively. The following items are included:

- **Sampling / Analytical Objective** - Rationale for collecting sample.
- **Data Quality Objective (DQO) Level** - DQO USEPA definitive data - level III
- **Parameters To Be Tested** - The contaminant(s) or parameter(s) to be evaluated
- **Sampling or Monitoring Method** - Description of the sampling technique (e.g., grab sample collected or "bubble strip method", methanol preservation)
- **Sample Containers** - Further information regarding sample container, preservation, and holding times is included in Table 2-2.
- **Expected Number of Samples for Analysis** - An estimate of the number of samples.
- **Analytical Methods** - Detailed descriptions of the analytical procedures, including modifications of the methods (if any), are presented in Appendix A.
- **QA/QC Samples** - The frequency of analysis of QA/QC samples (i.e. field duplicates, rinsate blanks, laboratory blanks, blank spikes, matrix spikes, matrix spike duplicates, trip blanks, and sample replicates).

Table 2-1

Summary of Sampling and Analysis Procedures for BROS NPL SITE- OEL

Sample Point Description	Contaminate Determination
Sampling / Analytical Objective	Determine Contaminate Concentrations
DQO Level	Definitive Level III
Parameters To Be Tested	Total Lead, Volatile Organics (VOCs) (GRO) Semivolatile Organics (DRO) Hydrocarbons (SVOCs) PCBs, Natural Attenuation Parameters
Turnaround Time	24 hours
Sample Containers	Metals (Pb) - Plastic Bags or 9 oz glass jars Volatiles (VOCs)(GRO)- 40 ml vials and 2 oz sample jars Semivolatiles (SVOCs), (PCBs), (DRO) 1L amber glass 9oz sample jar glass
Expected Number of Samples for Analysis	500
Analytical Methods	SW846 - 0030/5030B/5035/8260B - VOCs (GRO) SW846 - 3510C/3540C/8015B -SVOCs (DRO) SW846 - 3510C/3540C /80820 - PCBs USEPA- FMC-I-001 EDXRF Analysis of Soils and Sediments Natural Attenuation Methods

Table 2-1

(Continued)

Summary of Sampling and Analysis Procedures for BROS NPL Site- OEL

Sample Point Description	Soil	Water
Field Duplicates	10%	10%
Rinsate Blanks	as required by method	as required by method
Laboratory Blanks	1 per day or batch	1 per day or batch
Blank Spikes	1 per 20 samples	1 per 20 samples
Matrix Spikes	1 per 20 samples	1 per 20 samples
Matrix Spike Duplicates	1 per 20 samples	1 per 20 samples
Trip Blank	for VOAs only	for VOAs only

Table 2-3

Sample Requirements for BROS NPL Site - OEL

Parameter	Matrix	Container	Preservative	Holding Time
VOCs (GRO)	Soil	2 oz soil jar	Cool, 4 deg C	14 days
	Water	40 ml vial		
SVOCs (DRO)	Soil	9 oz soil jar	Cool, 4 deg C	7 days
	Water	1 liter amber		
PCBs	Soil	9 oz soil jar	Cool, 4 deg C	7 days
	Water	1 liter amber		
Lead	Soil	Plastic Bag, 90z soil jar	Cool, 4 deg C	128 days

Table 2-3 Continued. Natural Attenuation Parameters

Analyte	Method	SQL or Range	Bottle Required	Preservative	Holding Time
	Mode of Assay	(Identify Units)			
Dissolved Oxygen	Electrode A4500	0-15 mg/l	100 ml 16 oz plastic or glass	None Cool to 4 deg C	Immediately
Nitrite	Colorimetric HACH 8507	0-0.35 mg/l	100 ml 16 oz plastic or glass	None Cool to 4 deg C	14 Days
Nitrate	Cadmium Red EPA 353	0-30 mg/l	100 ml 16 oz plastic or glass	H ₂ SO ₄ > 2 pH Cool to 4 deg C	48 Hours
Ammonia/Ammonium	Colorimetric HACH 8038	0-0.5 mg/l	100 ml 16 oz plastic or glass	None H ₂ SO ₄ > 2 pH	28 Days
Alkalinity CO2 per A4500	A2370 HACH 8221	10-4000 mg/l	100 ml 16 oz plastic or glass	None Cool to 4 deg C	28 Days
Chloride	Titration (AgNO ₃) HACH 8225	10-8000 mg/l	100 ml 16 oz plastic or glass	None Cool to 4 deg C	28 Days
Sulfate (SO ₄ ²⁻)	Turbidimetric HACH 8051	0-70 mg/l	100 ml 16 oz plastic or glass	None Cool to 4 deg C	28 Days
Sulfide	Colorimetric HACH 8131	0-0.7 mg/l	100 ml 16 oz plastic or glass	None Cool to 4 deg C	7 Days
Iron II (ferrous-iron, Fe ²⁺) Ferric Iron (via subtraction of ferrous Iron from total Iron)	A3500 G123-94B	0-10 mg/l	100 ml 16 oz plastic or glass	None Cool to 4 deg C	Immediately
Methane Ethane Ethene	EPA 3810 EPA 3810 EPA 3810	0.004 mg 0.8 mg 0.11 mg	3 x 40 ml voa bottle No Headspace	None Cool to 4 deg C	Immediately
Hydrogen	Reduction Gas Detector	0.064-14 nmol 0.064-14 nmol	3 x 40 ml voa bottle No Headspace	None Cool to 4 deg C	Immediately
	Equilibrium with gas in the field Determined with a reducing gas detector	1 ppb 5 ppb	2 Gas tight syringes		Immediately

3. PROJECT ORGANIZATION AND RESPONSIBILITIES FOR QUALITY CONTROL

3.1 PROJECT MANAGER

Mr. John Hawkins is Analytical Project Manager for this project. He will be responsible for overseeing the detailed management of all aspects of project implementation, especially those related to compliance with the project plans, schedule, and finance.

3.2 LABORATORY MANAGER

Mr. Lonnie Fallin (OEL), will be the laboratory manager, and is responsible for the detailed management of all aspects of project implementation, including quality and production. Responsibilities include coordinating the activities of the laboratory on the project. The laboratory staff reports to him and act at his direction.

The Laboratory Manager's responsibilities will include:

- Completing the analyses in accordance with the planning documents.
- Ensuring that the work is done in a safe and environmentally sound manner.
- Preparing the required reports and submitting them to ROUX ASSOCIATES INC in a timely manner.
- Immediate notifying ROUX ASSOCIATES INC with the health and safety procedures.
- Ensuring that the site personnel follow the approved procedures presented in the LQAP.
- Sample preservation and transportation.
- Sample Chain-of-Custody.
- Field documentation / tracking.
- Field calibration of equipment.
- Accuracy of field calculations.
- He will be responsible for implementing corrective measures to ensure the quality of on-site analytical data.

3.3 ON-SITE LABORATORY CHEMIST

ONSITE Environmental Laboratories, Inc. will provide trained and experienced chemist and technicians for the analysis of the BROS NPL site samples. They are experienced in

performance of RI/FS programs, Remediation Support and Natural Attenuation sample analysis.

3.4 LABORATORY QUALITY ASSURANCE MANAGEMENT

Ms. Elizabeth Gomez will provide quality assurance oversight for the BROS NPL site project. She will review the data summary packages weekly.

4. SAMPLE HANDLING AND CHAIN OF CUSTODY PROCEDURES FOR BROS NPL SITE SAMPLES

4.1 SAMPLE HANDLING AND CHAIN OF CUSTODY

An overriding consideration for environmental measurement data is the ability to demonstrate that samples have been obtained from the location stated and that they have reached the laboratory without alteration. Evidence of collection, shipment, laboratory receipt, and the laboratory custody until disposal of the sample will be documented to demonstrate this ability. Documentation will be accomplished through a chain-of-custody record that documents each off-site sample and the individuals responsible for sample collection, shipment, and receipt. A sample is considered fit "in custody" if it:

- Is in a person's actual possession.
- Is in view after being in physical possession.
- Is locked up so that no one can tamper with it after it has been in physical custody.
- Is in a secured area, restricted to authorized personnel only.
- Is analyzed directly in the field and not transported
- Is analyzed immediately upon receipt into lab and handled by technician/chemist who collected sample initially

Sample custody will be initiated by the sample collection team or ROUX ASSOCIATES INC staff upon collection of samples. Documents specifically prepared for such purposes will be used for recording pertinent information about the sample, sample type, numbers of samples collected and scheduled for analysis. Example chain-of-custody forms are found in Figures 4-1 and 4-2. Copies of all chain-of-custody forms will be maintained for the project record. Custody seals will be used on all coolers being sent off-site.

Storage of samples by the laboratory will be under the conditions specified for the analyses to be performed. Samples will be handled by the laboratory as described in the subsections that follow.





A

APPENDIX A

CROSS-WALK BETWEEN ELEMENTS OF EPA-QA/R5 AND ELEMENTS OF THE QAPP

APPENDIX A
Cross-Walk Between Elements of
EPA-QA/R5 and Elements of the QAPP

EPA-QA/R5 Element	Corresponding QAPP Element
A1. Title and Approval Sheet	Document Cover Sheet
A2. Table of Contents	Pages i to iii
A3. Distribution List	See Letter of Transmittal
A4. Project/Task Organization	Section 2.0
A5. Project Definition/Background	Appendix B
A6. Project/Task Description	Appendix B, Table 2, Table 3
A7. Quality Objectives and Criteria for Measurement Data	Section 3.2, Section 7.0, Appendix B
A8. Project Narrative	Section 3.2, Section 5.0, Section 6.0, Section 7.0, Section 9.0, Section 10.0, Section 11.0, Table 5
A9. Special Training Requirements/Certification	Section 2.0, Appendix C, Attachment 4
B1. Sampling Process Design	Section 3.2, Section 5.0, Sampling and Analysis Plan
B2. Sampling Method Requirements	Section 8.1, Sampling and Analysis Plan
B3. Sample Handling and Custody	Section 6.0, Sampling and Analysis Plan
B4. Analytical Method Requirements	Section 3.2, Section 7.9, Table 5
B5. Quality Control Requirements	Section 8.0, Attachment 1, Table 5
B6. Instrument/Equipment Testing, Inspection and Maintenance Requirements	Section 9.0
B7. Instrument Calibration and Frequency	Section 10.0
B8. Inspection/Acceptance Requirements for Supplies and Consumables	Attachment 1
B9. Data Acquisition Requirements	Section 3.2, Appendix B
B10. Data Management	Section 14.0, Section 15.0
C1. Assessment and Response Actions	Section 11.0, Section 12.0
C2. Reports to Management	Section 13.0
D1. Data Review, Validation and Verification Requirements	Section 14.2, Section 14.3
D2. Validation and Verification Methods	Section 14.2, Section 14.3
D3. Reconciliation with Use Requirements	Section 14.3, Section 15.0

B

APPENDIX B
DESCRIPTION OF PLANNED ACTIVITIES
AND OBJECTIVES

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APPENDIX B

Description Of Planned Activities And Objectives

Introduction

The Bridgeport Rental and Oil Services (BROS) Superfund Site is located on Cedar Swamp Road in Logan Township, Gloucester County, New Jersey. At various times, the current and previous owners and operators used the site for several purposes, including waste oil reprocessing, waste disposal, and waste storage. The United States Environmental Protection Agency (USEPA) placed the site on the National Priorities List on September 8, 1983 (See 48 Fed. Reg. 40, 658) and commenced a Remedial Investigation and Feasibility Study (RI/FS).

The RI/FS identified several sources of contamination and various contaminated areas. On December 31, 1984, USEPA issued a Record of Decision (ROD) which called for: (1) installation of a water supply line to replace private water supplies near the site; (2) dismantling of the tank farm at the site; (3) excavation and on-site incineration of lagoon sediment; and (4) performance of a Phase 2 RI/FS to address ground water at and emanating from the site.

Two major law suits were filed with regard to the BROS site. On March 20, 1992, thirteen private parties filed suit in *Rollins Environmental Services (NJ) Inc., et al. v. United States, et al.* against the United States Department of Defense and certain named departments and agencies (including the Defense Logistics Agency and the Departments of the Army, Air Force, and Navy) and certain private parties. On June 30, 1992, the United States of America, on behalf of USEPA, filed a complaint against a number of corporate defendants in *United States v. Allied Signal, Inc.* The complaint was amended on November 30, 1992 (USDC, 1997a).

The Court consolidated the *Allied Signal* and *Rollins* cases on October 2, 1992. On March 31, 1993, the State of New Jersey, Department of Environmental Protection (NJDEP) intervened in the *Allied Signal* action as a plaintiff. In May 1993, the *Allied Signal* defendants counter-claimed against NJDEP and asserted claims against the New Jersey Department of Military and Veterans Affairs and the New Jersey Department of Transportation.

The *Rollins* and *Allied Signal* cases were essentially resolved by a Consent Decree entered by the Court on January 17, 1997 (USDC, 1997a). Under that Consent Decree, which provided for financial contributions to the ongoing BROS cleanup from federal, state, and private PRPs; the Settling Defendants, including a number of private parties allowed by the Court to intervene as defendants in the *Allied Signal* action for the purpose of participating in the Consent Decree, assumed responsibility for implementation of the Phase 2 RI/FS activities intended to identify remedial actions for ground water and wetlands.

The BROS Technical Committee, composed of senior managers employed by certain Settling Defendants, selected Environmental Liability Management, Inc. as the Project Coordinator and Roux Associates, Inc. as the contractor to develop and implement the Phase 2 RI/FS activities. These activities are outlined in the Statement of Work in the Consent Decree and detailed in this Work Plan and its associated documents. The information generated and compiled during the Phase 2 RI/FS, including public participation, will be used to select the remedial action or actions for ground water and wetlands. These remedial actions may include actions to address the residual contamination in the soils at the BROS property and final closure of the incinerator ash management unit. USEPA will describe the scope of these actions and how they were selected in a Phase 2 Record of Decision (ROD).

Overview of Phase 2 RI/FS Work Plan

The purpose of the Phase 2 Remedial Investigation/Feasibility Study (RI/FS) Work Plan is to describe the tasks and supporting rationale for the proposed assessment of site conditions and evaluation of alternatives to the extent necessary to select a remedy for the BROS Superfund site. Consistent with the Statement of Work in the Consent Decree, the Work Plan is based upon evaluations conducted during the scoping process, including a review of available data from prior investigations and remedial actions at the site. In addition, in the preparation of the Work Plan Roux Associates, Inc. relied on the National Contingency Plan (NCP, 1990), the New Jersey *Technical Requirements for Site Remediation* (N.J.A.C. 7:26E), and the USEPA *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (USEPA, 1988a). Other documents were concurrently developed and are cross-referenced in the Work Plan including the Quality Assurance Project Plan (QAPP), Sampling and Analysis Plan (SAP) and Health and Safety Contingency Plan (HASCP).

The Phase 2 RI study will collect the data necessary to adequately characterize the site for the purpose of developing and evaluating effective remedial alternatives, building upon the previously conducted studies and remedial actions. In addition, the Phase 2 RI site characterization will provide the information necessary for the completion of a site-specific baseline risk assessment which will evaluate the current and potential threats to human health and the environment that may be posed by residual contaminants in ground water, surface water, air, soil, sediment or potentially bioaccumulating in the food chain. The risk assessment will be used to support the development, evaluation, and selection of appropriate response alternatives in the Phase 2 FS (USEPA, 1998f).

The primary objective of the Phase 2 FS will be to ensure that appropriate remedial alternatives are developed and evaluated so that relevant information concerning the remedial action options can be presented to a decision-maker and an appropriate remedy can be selected. Development of the alternatives will be fully integrated with the site characterization activities of the Phase 2

RI. Alternatives will be developed to protect human health and the environment by eliminating, reducing, and/or controlling risks arising from each pathway associated with the entire site as well as risks arising from specific areas of concern or hot spots.

Site History

The BROS site is located on Cedar Swamp Road between US Route 130 and Interstate 295 (Figure 1). This site includes a 30-acre facility formerly used (First by Regal Petroleum and then by Bridgeport Rental and Oil Services) for waste oil reprocessing, waste disposal, and waste storage and now known as the BROS property. All industrial operations associated with waste oil have been shut down and the equipment removed. In addition to the BROS property, the BROS site is defined in the 1997 Consent Decree to include all areas adjacent to the BROS property where contamination exists as a result of the past operations.

Prior to the initiation of waste oil operations, the BROS property was an upland farm area that was subsequently used for a sand mining operation with the excavation extending below the water table. A 13-acre pond remained on the property when the upland portion of the BROS property was developed into a waste oil operation around 1960. During the period of waste oil operations, between 1960 and the early 1980s, industrial operations occurred primarily in three areas: the waste oil processing and storage tank area, a building known as the Pepper Building, and the 13-acre pond which became a waste oil lagoon (Figure 2). The operations resulted in oil-based and aqueous based contamination of soils and ground water. In 1972, following heavy rains associated with a hurricane, the lagoon overflowed into the adjacent Little Timber Creek Swamp. Interim lagoon stabilization actions were taken during the 1970s. The USEPA initiated a series of response actions in 1981 and began remedial actions following the signing of the 1984 ROD.

Since the issuance of the 1984 ROD, the following remedial actions have been completed:

- installation of potable water lines in the vicinity of those known residences whose supply wells could potentially contain site-related constituents;
- demolition and removal of the tanks, process vessels and underground piping;
- on-site incineration of oil, sludge, sediment and soil from the former lagoon;
- on-site treatment and discharge of 190 million gallons of ground water pumped from the lagoon during the incineration work;

- removal of sediment from a limited area in the adjacent wetlands, east of the former tank storage area and near US Route 130;
- on-site disposal of the incineration ash in the former lagoon area; and
- off-site disposal of debris and other materials which could not be incinerated on-site.

Current BROS Property Condition

Currently, the former lagoon area and the former waste oil processing and tank storage area are grass covered. The areas have been backfilled with off-site soils and incinerator ash from the on site lagoon incineration activities. Soils from off-site were also used to cover the ash layer prior to seeding. The Pepper Building remains in essentially the same condition that it was in at the time of the 1984 ROD. Two office trailers, utilized by USEPA during incineration activities, remain on the BROS property for use during the Phase 2 RI/FS. In addition, the former waste water treatment plant, constructed by USEPA's contractor and utilized during both the tank farm demolition activities and the on-site incineration project, remains on the BROS property in a decommissioned condition. The BROS property is surrounded by a fence.

Environmental Setting and Quality

The USEPA conducted preliminary remedial investigation activities to assess the quality of soils, ground water, and wetlands at the site. Data from these investigation activities are summarized in a report compiled by the USEPA's contractor (CH₂M Hill, 1996). This Work Plan was developed, in part, utilizing those data as well as other sources of site information, including data from the US Army Corps of Engineers on the lagoon work, data and observations from the recent soil sampling work conducted on the BROS property by a USEPA contractor, and information from similar investigations conducted at the nearby Chemical Leaman Tank Lines Superfund Site. All of the sources of information were used in this Executive Summary and the Work Plan, unless noted otherwise.

The BROS site lies within the Atlantic Coastal Plain physiographic province which is characterized by relatively flat topography, low gradient streams, and a series of alternating sand and clay dominated subsurface formations overlying bedrock. A thin surface strata of recent alluvium covers the Upper Potomac-Raritan-Magothy Formation (Upper PRM) which is under water table conditions near the surface. Recent fill material, alluvium, and peat layers associated with current and past wetland areas are mixed on the BROS property. The thickness of the Upper PRM ranges from 10 to 80 feet beneath the site. Soil contamination, primarily petroleum hydrocarbons, lead, and volatile organic compounds (VOCs) has been detected in subsurface soils beneath the BROS property. Based on the limited data the distribution of site-related

constituents in soil beyond the BROS property appears limited to the immediate vicinity of the property.

Petroleum hydrocarbons in the form of light non-aqueous phase liquids (LNAPL) have been reported in several locations throughout the BROS property, including: near the southwest side of the Pepper Building, beneath the former lagoon, around the perimeter of the former lagoon, and in the former tank storage area. Recent soil borings reportedly detected LNAPL several feet below the current water table at several locations on the BROS property. Some ground water monitoring wells contain measurable quantities of LNAPL. In close proximity to the BROS property, LNAPL residuals have been reported in two locations: on the water table below the swale along U.S. Route 130 and in sediment in the Little Timber Creek Swamp. The distribution, characteristics, and composition of LNAPL in soils at or in close proximity to the site are not known in adequate detail. In wetland sediments, the distribution of residual LNAPL appears to be related to the distribution of emergent herbaceous vegetation (*Phragmites*) in the otherwise swamp habitat, dominated by red maple overstory trees.

Sediment and surface water contamination has been detected in Gaventa Pond near a former seep from the former waste oil lagoon and in Little Timber Creek Swamp as a result of the 1972 lagoon overflow. The principal site-related constituents for these areas include petroleum hydrocarbons, lead and PCBs. Metals were also detected in one sediment sample collected from Swindell Pond at concentrations in excess of screening criteria. In Swindell Pond, no VOCs, SVOCs or PCBs were detected in sediments at concentrations exceeding the screening criteria and contamination was not detected in surface water. Limited additional delineation is needed in Gaventa and Swindell Ponds, but significant additional evaluation of the distribution and characteristics of contaminants in surface water and sediment is necessary in Little Timber Creek Swamp, including the area between U.S. Route 130 and Cedar Swamp Road.

Ground water flow in the Upper PRM is driven by local topography and surface water-ground water interaction. Currently, the ground water flow pattern in the Recent strata and the Upper PRM at the BROS property is not known with any certainty because the hydrology has been modified by remedial activities and no data have been collected since the cessation of the lagoon dewatering activities and the back filling of the former lagoon. Historically, the liquid in the lagoon was a mound in relation to adjacent ground water. The lagoon area then became a ground water depression point for a number of years as a result of lagoon remedial activities which included dewatering of soils by lowering the water table. The distribution of site-related contamination, primarily volatile organic compounds, in the Upper PRM appears limited to the BROS property and its close proximity. However, the distribution and concentrations of site-constituents is not known beneath the Little Timber Creek Swamp adjacent to the BROS property. In addition, the influence of several years of lagoon excavation and ground water

withdrawal on the ground water quality in the Upper PRM is not known because sampling has not been conducted since 1993 and the lagoon remedial activities, including dewatering, continued until the end of 1996.

Beneath the Upper PRM is a confining layer which may be discontinuous beneath a portion of the former waste oil lagoon based on its reported absence at one location along the southeast side of the former lagoon. Elsewhere throughout the site, the confining layer has been clearly documented and is approximately 15 feet thick. If the confining clay is absent beneath a portion of the lagoon, which has not been confirmed, the gap in the confining layer may have provided a pathway for the movement of ground water contaminants downward into the Upper Middle PRM. This might have been possible especially during the period when water was mounded in the lagoon or when lagoon dewatering was suspended during incinerator down times, allowing ground water elevations to recover in the excavation. However, no stratigraphic information is available from beneath the former 13-acre lagoon, and no soil samples have been collected from the confining layer and analyzed for site-related constituents.

Beneath the upper confining layer is the Upper Middle PRM, a semi-confined aquifer that ranges in thickness from 40 to 90 feet. In the early 1990's, the vertical direction of ground water flow was upward, except at one location. Ground water contamination consists primarily of volatile organic compounds which are distributed in the Upper Middle PRM along the direction of ground water flow to the southeast, in the vicinity of Interstate Route 295 (Figure 3). Concentrations decrease substantially with distance from the former lagoon. Drinking water standards along Interstate Route 295 are exceeded minimally for only two constituents. Further southeast and downgradient along Swedesboro-Paulsboro Road, there have been no site-related contaminants detected above ground water standards. The reported detection of two potentially site-related constituents in one well has not been confirmed. Consequently, the downgradient distribution of site-related constituents is not clearly established.

The Lower Middle PRM underlies the Upper Middle PRM and is separated by a continuous clay layer which ranges in thickness from 8 to 20 feet beneath the BROS site (CH₂M Hill, 1996a). Some low concentrations (less than 10 ppb) of VOCs were detected in some wells in the Lower Middle PRM near the former lagoon, but they may be the result of carrydown from the Upper Middle PRM during drilling or as a result of movement along the casing of the well. No further assessment of the Lower Middle PRM is proposed due to the low concentrations detected (CH₂M Hill, 1996a) and the subsequent removal of the primary source (the former lagoon).

Specific Phase 2 RI/FS Objectives and Data Needs

The specific Phase 2 RI/FS objectives are a function of the data needs which were identified and refined during the Work Plan scoping process. The new data and additional information

collected during the Phase 2 RI/FS will be used to complete the compilation of the relevant information needed for the selection of remedial options. The remainder of this section summarizes the Phase 2 RI/FS objectives and data needs which have been integrated into the scope of work presented in the Work Plan.

Objective 1 - Establish a Water Budget for the Site

Data and Technical Evaluation Needs:

- Establish the direction and magnitude of water movement through various environmental compartments at the site, especially the discharge/recharge relationship between ground water and surface water.
- Understand the fluctuations in flow and discharge/recharge relationships caused by seasonal changes and precipitation events.
- Determine the relative potential for contaminant movement through aqueous pathways; soil leaching, incinerator ash/lime leaching, ground water movement, and surface water transport.
- Evaluate the effects of various potential remedial alternatives (i.e., capping, pumping and treatment, engineering containment) on the movement of water and associated contaminants as well as on the hydrology of the adjacent wetlands.

The water budget analysis, linked with other sampling and evaluation activities, will satisfy the data needs identified above. Based on the water budget evaluation results, the conceptual site model will be refined and provide the template for the fate and transport assessment which will be used in human health risk assessment, ecological risk assessment, and the Phase 2 FS.

Objective 2 - Establish the Spatial Distribution, Volume and Mass of Contaminants Associated with Residual Source Areas

Data and Technical Evaluation Needs:

- Determine the vertical and horizontal distribution of free product; defined as the LNAPL that would flow into a well or other recovery point.
- Evaluate the recoverability of the free product (LNAPL).
- Determine the vertical and horizontal distribution of residual product; defined as the LNAPL that remains in the soil pore space but will not flow into a well or other recovery point.

- Characterize the constituents of the LNAPL at various locations on the BROS property and in the adjacent wetlands.
- Estimate the mass of LNAPL above and below the current water table.
- Determine the relative mobility potential of the constituents of the LNAPL.
- Understand the physical (e.g., viscosity, BTU value) and chemical characteristics of the LNAPL in the former Process and Tank Areas and lagoon residuals below and around the excavation limits of the incineration work.
- Determine the vertical and horizontal distribution of the peat layer encountered below the former Process and Tank Areas and at the base of the lagoon excavation.
- Understand the physical, hydrologic, and chemical characteristics of the peat layer beneath the former lagoon, especially its hydraulic conductivity and chlorinated solvent content.
- Determine the vertical and horizontal distribution of the Constituents of Potential Concern (COPCs) in former source areas (Process Area, Tank Area, Lagoon). COPCs include chlorinated solvents (i.e., PCE, TCE) nonchlorinated solvents (BTEX), lead, and PCBs.
- Evaluate the Pepper Building for potential residual sources of contamination.
- Screen for DNAPL below the former Process and Tank Areas and the former lagoon.

Characterization of the secondary sources of contamination associated with the former primary sources of contamination is necessary to evaluate: the risks posed by the site currently and in the future; the reduction in toxicity, mobility, and volume resulting from the treatment of lagoon materials; the probable effectiveness and implementability of potential remedial alternatives; and reasonable restoration timeframes, considering the difficulty of remediating LNAPL (and, if present, DNAPL) which is trapped at least in part below the water table.

Objective 3 - Establish the Vertical Distribution and Characteristics of the Fill, Ash and Lime, and Cover Material Layers in the Former Lagoon

Data and Technical Evaluation Needs:

In order to complete the closure of the incinerator ash management unit and determine the hydrology in the former lagoon area, additional data are needed to augment the existing information.

- Detail the as-built specifications of the residuals placed into the lagoon during Phase I, including the thickness and elevation of each layer placed in the former lagoon and how the thickness varies.
- Determine the physical, chemical, and hydrologic characteristics of the materials and/or layers in the former lagoon.

Objective 4 - Determine the Distribution and Gradients of COPCs Along Potential Exposure Pathways Under Current Site Conditions

The substantial changes in the site conditions would naturally result from the lagoon incineration work and the associated ground water pumping. These changes will have altered the hydrology and influenced the distribution and concentration gradients of COPCs in the vicinity of the former lagoon. The data for the site are at least 5 to 8 years old and several data gaps are now apparent. The data needs to determine current conditions for specific areas of the site are summarized below.

Off-Property Soils (Beyond BROS Property)

Data and Technical Evaluation Needs:

- Determine background soil quality by soil sampling at multiple locations (e.g. peach orchard and southeast of Route I-295).
- Survey the BROS property to determine the precise property boundaries.
- Delineate the vertical and horizontal distribution of site-related constituents which extend beyond the BROS property. This is especially important near Cedar Swamp Road and U.S. Route 130.

Gaventa and Swindell Ponds

Data and Technical Evaluation Needs:

- Complete the evaluation of the distribution of Constituents of Potential Ecological

(COPECs) as well as the gradients of COPECs in surface water and sediments in the northwest corner of Gaventa Pond. Given the age of some data it is important to confirm the previous analytical results for Swindell Pond

- Evaluate the hydrologic conditions and interactions between Gaventa and Swindell Ponds, ground water and the Little Timber Creek Swamp.

Little Timber Creek Swamp - Between Interstate Route 295 and U.S. Route 130 and Between U.S. Route 130 and Cedar Swamp Road

Data and Technical Evaluation Needs:

- Wetland delineation.
- Identify the vertical and horizontal distribution of COPECs in sediment.
- Understand the surface water flow pattern or patterns in the swamp.
- Identify and compare the horizontal distribution of COPECs in surface water as related to and compared with sediment concentrations.
- Identify the key species utilizing the swamp and determine the assessment endpoints.
- Identify the distribution of key species in relation to surface water and sediment concentrations.
- Characterize the areas dominated by *Phragmites* which contain residual LNAPL in sediment for evaluation of restoration alternatives as part of the Feasibility Study.
- Identification and characterization of reference areas.

Little Timber Creek Swamp - Between Cedar Swamp Road and the Tide Gate Along Route 44

Data and Technical Evaluation Needs:

- Wetland delineation.
- Identify the vertical and horizontal distribution of COPECs in sediment.
- Identify the key species utilizing the swamp and determine the assessment endpoints.

- Evaluate the concentration gradients of COPECs in the downstream direction of Little Timber Creek. Identify the horizontal distribution of COPECs in surface water as related to sediment concentrations.
- Identify the horizontal distribution of key species in relation to surface water and sediment concentrations.

Cedar Swamp - Downstream of the Tide Gate.

Data and Technical Evaluation Needs:

- Wetland delineation.
- Evaluate the presence or absence of COPECs in depositional areas along the drainage channel downstream of the tide gate.

Ground Water - Upper PRM and Recent Alluvium

Data and Technical Evaluation Needs:

- Determine the current concentrations of COPCs representative of ground water quality after the conclusion of the lagoon work and determination of ground water flow near the former lagoon under existing hydrogeologic conditions.
- Vertical and horizontal distribution of COPC beneath Little Timber Creek Swamp.
- Horizontal distribution of COPCs beneath the former lagoon.
- Concentrations of COPCs possibly discharging to surface water in Little Timber Creek Swamp.
- Potential for sediment contamination to mobilize and influence ground water quality during periods when surface water recharges ground water.
- Horizontal distribution of dissolved COPCs in the former Process and Tank Areas.
- Evaluate the potential occurrence of DNAPL below the former Process and Tank Areas and the former lagoon.

Ground Water - Upper Confining Layer

Data and Technical Evaluation Needs:

- Evaluate the vertical and horizontal extent of the strata beneath the former Process and Tank Areas, the former lagoon, the Little Timber Creek Swamp adjacent to the BROS property and to the north of Route 130.
- Determine concentrations and vertical distribution of COPCs in soils of this confining layer.

Ground Water - Upper Middle PRM

Data and Technical Evaluation Needs:

- Concentrations of COPCs representative of current ground water quality conditions.
- Vertical distribution of COPCs within the aquifer, especially below and near the former lagoon.
- Evaluate the potential occurrence of DNAPL below the former lagoon area.
- Horizontal distribution of COPCs beneath Little Timber Creek Swamp adjacent to the BROS property and between Interstate Route 295 and Swedesboro-Paulsboro Road.

Objective 5 - Establish the Degree of Hydraulic Connections Between the Aquifers and Surface Water

Data and Technical Evaluation Needs:

- Evaluate seasonally the flow direction and probable magnitude of flow between Swindell and Gaventa Ponds and the Upper PRM and Upper Middle PRM.
- Evaluate seasonally the flow direction and probable magnitude of flow between the Upper PRM and the Little Timber Creek Swamp.
- Determine the influence of pumping ground water in the Upper PRM on the Little Timber Creek Swamp, the adjacent ponds, and the Upper Middle PRM beneath the former lagoon.
- Determine the influence of pumping ground water in the Upper Middle PRM on the Little Timber Creek Swamp, the adjacent ponds, and the Upper PRM around the former lagoon. The degree of hydraulic interconnection between the Upper PRM and Upper Middle PRM will need to be specifically evaluated near the former lagoon.

These data will also be used in the water budget analysis, fate and transport assessment of COPC, and feasibility study.

Objective 6 - Establish the Hydrogeologic and Chemical Relationship Between the Chemical Leaman Tank Lines (CLTL) Site and BROS site

Data and Technical Evaluation Needs:

- Evaluate the hydrogeology of the CLTL site to determine the interaction, if any, between the two sites and potential effects of the CLTL ground water remedial system on ground water flow and contaminant fate and transport at the BROS site.
- Determine the extent of the clay confining layer between the Upper PRM and Upper Middle PRM in the area between the CLTL property and the BROS property.
- Evaluate the chemical constituents of concern associated with the CLTL site as compared or contrasted to those associated with the BROS site.
- At the direction of USEPA, evaluate the vertical and horizontal extent of CLTL-related constituents to assess whether potential remedial technologies at the BROS site will influence the remedial action at the CLTL site (for example, through mobilization of contaminants or alteration of extraction system capture zones).

Objective 7 - Assess the Environmental Fate and Transport of COPCs Under Current Site Conditions and Assess the Future Fate and Transport of COPCs

The Phase 2 RI/FS is a retrospective study, meaning the release of contaminants from the BROS waste oil operation occurred primarily in the past and the primary sources of contamination have been removed. Consequently, the mass loading of contaminants into potential exposure pathways has been decreased substantially and will continue to decline in the future. Under such conditions, the most direct way to evaluate the environmental fate and transport of COPC is to measure the concentration trends along exposure pathways over time at various points along concentration gradients of contamination. However, assessment and modeling of various factors that affect the rate of natural attenuation must also be evaluated separately, including: the biological and chemical degradability of the contaminants, the physical and chemical characteristics of the media, and physical characteristics of the geological medium. The data needs identified below relate to completing the fate and transport assessment of COPCs under current and future conditions.

Data and Technical Evaluation Needs:

- Determine if the distribution of site-related constituents in the Upper PRM and Upper Middle PRM is expanding, stable or decreasing.
- Identify the physical and chemical characteristics that impact the evaluation of the natural attenuation mechanisms and processes in various environmental media.
- Estimate the rates of degradation of the organic COPC in various media and in various portions of the site.
- Determine the chemical and biological degradability of the contaminants under the various physical and chemical characteristics present at the site.
- Characterize the mechanisms of sequestration of COPC and identify the adsorptive and exchange capacities of the various media and across the site.
- Determine the physical characteristics of the geological media as necessary to assess and model the environmental fate and transport of the COPC.
- Based upon the results of additional chemical, hydrologic, and stratigraphic evaluations, evaluate the rate of chemical transport in different geologic media encountered below the site using column leaching studies.

Objective 8 - Determine Representative Exposure Point Concentrations and Characterize Potential Receptors

A large amount of data has been generated for the site over the past twenty years. However, to accurately estimate the exposure point concentrations and the risks arising from those concentrations, the exposure point concentrations must be specifically measured in a manner that can be related directly to current or potential future receptors, human or ecological (USEPA, 1998f). Exposure estimates must be conservative but within a realistic range of exposure, where unlikely exposure scenarios are eliminated from consideration consistent with USEPA policy and guidance (USEPA, 1995). In considering land use and ground water use, Superfund exposure assessments most often classify land use into one of three categories (1) residential, (2) commercial/industrial, and (3) recreational; and ground water use is classified as potable or non-potable use.

In May 1997, the Settling Defendants reached an agreement with the owners of the BROS property that three perpetual deed restrictions in the form of Declaration Restrictive Covenants would be promptly established for the BROS property, which include the Pepper Building, the

former Lagoon and former Process Areas. These deed restrictions are currently in place and properly recorded. The provisions of the restrictions include:

- Future use of the property excludes residential use and limits other uses to non-retail commercial and/or industrial use. These uses are consistent with the use at the time the release of hazardous substances began.
- All subsurface activities (e.g., digging) are prohibited without prior written approval of the USEPA and NJDEP.
- The installation and/or use of any ground water wells at the site is prohibited without prior written approval of the USEPA and the NJDEP.

Beyond the BROS property, ground water use throughout the site is limited because most residents have connected to the municipal water supply which has also been made available to residents near the site. Consequently, the portion of the site beyond the BROS Property boundary area will be considered a potential future potable supply source but the current use risk assessment will be based on conditions established as part of this scope of work.

Data and Technical Evaluation Needs:

- Identify current and probable future ground water users that have the potential to be exposed to site-related contaminants.
- Determine representative human health risk assessment exposure point concentrations across various portions of the site in a manner consistent with current and future land use and/or water use.
- Identify ground water users and well configurations at the BROS site. Sample local private wells to evaluate the current extent and gradients of site-related COPCs in ground water and to assess representative COPC concentrations at potential receptor wells.
- Determine representative exposure point concentrations for key ecological receptors across various portions of the site.
- Annually evaluate the planned future use of land, especially land development proposals in the vicinity of the site by contacting the Logan Township Planning Board periodically throughout the duration of the Phase 2 RI/FS.

Objective 9 - Establish a Range of Remedial Alternatives that are Protective of Human Health and the Environment and Conduct Screening of Alternatives

In establishing the NCP-required range of remedial alternatives, several specific factors will be taken into account, including:

- there are various portions of the site where the distribution and composition of contamination varies and where the potential receptors may vary;
- guidance materials on the conventional methods, strategies, and technologies for ground water and volatile organic compounds in soils that are available (USEPA, 1993e; USEPA, 1996c);
- a variety of site-specific factors, such as LNAPL trapped below the water table and DNAPL (if present) , may make remediation impracticable by conventional methods and technologies;
- there are potential adverse effects on sensitive ecological environments from some remedial alternatives;
- there are human health risks posed by various remedial alternatives;
- a limited number of site-related constituents pose the majority of the risks in various media and the evaluation will need to consider the costs and benefits of reducing the principal and secondary risk factors;
- the effect of the CLTL remedial activities on the aquifers beneath the BROS Site;
- in Little Timber Creek Swamp, the areas dominated by *Phragmites* and containing elevated concentrations of site-related constituents are recognized at the start as probably requiring remedial action;
- institutional controls that may be developed or are already in place, such as ground water Classification Exception Areas and deed restrictions on the Borelli property;
- detailed evaluation of reasonable restoration times may be necessary in light of site-specific treatment limitations;

- a combination of remedial technologies and options as well as a phased remedial approach may be necessary to further reduce the toxicity, mobility, or volume of the remaining contamination, taking into account the treatment of wastes already completed.

In order to take these factors into account and develop an integrated remedial approach to the site, the data needs identified under the preceding objectives will be iteratively added into the feasibility study components.

Objective 10 - Conduct Relevant Treatability Studies

Based on data needs identified during the development and screening of remedial alternatives, treatability studies may be designed and conducted to reduce the uncertainty of whether some remedial technologies are feasible. Treatability studies will be described in a Technical Memorandum submitted to the USEPA after initiation of the field activities with the objective to complete the studies in time to be included in the FS Alternative Evaluation and in the Phase 2 RI/FS report.

Objective 11 - Complete the Cultural Resources Survey Requirements

Supplement the Stage 1A Cultural Resource Survey (CRS) to include the entire BROS site and conduct a Stage 1B CRS based on the previously completed Stage 1A CRS and the results of the supplemental Stage 1A CRS.

Phase 2 RI/FS Scope of Work

Consistent with the Phase 2 RI/FS objectives, the NCP, and the BROS Consent Decree, the scope of work is divided into nine tasks. Detailed descriptions of each task and the activities and deliverables to USEPA are provided in the Work Plan.

Task I - Scoping

- Process leading to USEPA approval of the Work Plan, Quality Assurance Plan, Sampling and Analysis Plan, and Health and Safety Contingency Plan.
- Preparatory activities such as the site property access agreements and the Stage 1B Cultural Resources Survey.
 - Activity 1a - Inspection and Repair of Existing Monitoring Wells;
 - Activity 1b - Evaluation of Ground Water Use On and Around the Site;
 - Activity 1c - Stage 1B Cultural Resources Survey;
 - Activity 1d - Permit Equivalent Requirements; and
 - Activity 1e - Obtain Property Access Agreements.
 - Activity 1f - Analytical Method Development

Task II - Community Relations

- USEPA-lead activity to inform the stakeholders and seek their input.

Task III - Site Characterization

- Process of determining the distribution and potential movement of site-related constituents in relation to potential receptors.

Task IIIA - Field Investigations

- Activity 1 - Water Budget Evaluations Including:
 - measurement, over a course of twelve months, of surface water and ground water elevations for each season of the year;
 - measurement of precipitation and the effect of precipitation on surface water and ground water elevations and flow rates based on hydrographs constructed from data collected at surface water flow gauging stations;
 - obtaining and evaluating monthly precipitation data from 1960 to the present in order to evaluate patterns of precipitation during the waste oil operations and determine the representativeness of the data measured in the Phase 2 RI/FS;
 - determination of the interaction between surface water and ground water through the use of staff gauges and clustered wells installed in different strata beneath the site, as well as aquifer pumping tests; and
 - analytical evaluation based on site-specific empirical data (modeling).
- Activity 2 - Soils Investigation. The soils investigation includes the analysis of the geochemical, geotechnical and stratigraphic properties of soils at the BROS site (Table 1).
 - *Background Soils* - Background soil samples will be collected to determine the concentrations of COPCs not related to activities historically performed at the BROS property that may be related to natural conditions (e.g., metals in soils) or regional issues (e.g., TPH).
 - *Former Process and Storage Tank Area* -Thirty soil borings will be completed in the former Process and Storage Tank Area, the area around and between the Pepper Building and the corner of Gaventa Pond, and the AWTS area including the wetlands immediately to the east (Figure 4).

- *Former Lagoon Area* - Soil borings will be completed in the former Lagoon Area to evaluate the distribution and characteristics of the chemical residuals remaining from the lagoon work (Figure 5). Ten soil borings (L-1 through L-8 plus MW-26 and MW-27) will be completed through the former lagoon to assess the configuration and relative thickness of the strata in the former lagoon, the water table location, and any perched water tables; to characterize the ash and sand layers; and to evaluate the characteristics of the residuals which underlie the former lagoon. In addition, eight transects (L-9 through L-16) containing two borings each for a total of 16 borings, will be completed radially around the former edge of the lagoon. The transects will be installed to assess the horizontal extent and characteristics of the lagoon residuals (including the mud wave) along the edge of the former lagoon. The borings will also be completed to evaluate if the clay confining layer above the Upper Middle PRM aquifer is present below the base of the lagoon and to support the analysis for potential DNAPL in both the Upper PRM and the Upper Middle PRM.
- *Ash* - The ash that was stabilized with lime was placed into the excavation of the former lagoon during the lagoon incineration remedial action. Although the ash was reportedly placed above the water table, precipitation infiltration percolating through the ash layer may affect the underlying and downgradient ground water geochemistry. Further, the ash/fill line may extend below the water table in some areas. The lagoon soil borings will be sampled continuously to identify the contact between the ash and backfill.
- *Backfill* - In addition to the ash, sand from the site (former berms) and off-site sources were used as backfill in the lagoon. In order to evaluate the potential affect of the sand backfill on the ground water geochemistry, five samples will be collected of the sand backfill below the ash layer.
- *Lagoon Residuals* - To evaluate the nature and extent of lagoon residuals and to determine if the lagoon residuals are impacting ground water, up to four samples from select borings will be collected for off-site laboratory analyses. Selected samples will be screened for the presence of LNAPL or DNAPL. Soil samples will also be collected for geochemical, hydrologic and geotechnical analyses.
- *Sampling Methodology* - Soil samples collected for VOC analysis will be preserved in the field using the NJDEP methanol preservation method. In order to establish the relationship between the new data and historical results, several collocated samples will also be preserved with ice, as was used in prior sampling events. These comparability tests are intended to provide a basis for use of existing data.
- Activity 3 - NAPL Investigation (Table 1) will be performed to delineate LNAPL: assess the recoverability of LNAPL; characterize LNAPL to assess treatability, fate and transport; and test for the presence of DNAPL. NAPL investigations will include:
 - Activity 3a - LNAPL physical characterization;
 - Activity 3b - NAPL chemical characterization;
 - Activity 3c - LNAPL distribution and volume estimates; and
 - Activity 3d - LNAPL recoverability analysis.

- Activity 4 - Ground Water Investigation
 - Activity 4a - Ground Water Quality Evaluation - A ground water quality evaluation will be conducted to evaluate the nature and extent of COPCs in ground water. The evaluation consists of the installation of new wells and ground water sampling. There are currently 62 monitoring wells installed on and around the BROS property. The Phase 2 RI activities will include the installation of 45 additional wells (Table 2) on and around the site (Figures 6, 7 and 8). The 45 wells include six pairs of wetlands monitoring wells, WMW-1 through WMW-6, which will be installed in the Little Timber Creek wetlands to evaluate the distribution of COPCs and the hydrology of the wetlands and underlying ground water. Additionally, slotted augers will be used to field screen the vertical extent of COPCs in ground water at five monitoring well locations (MW-17D, MW-18D, MW-19D, MW-33D and MW-34D) and optimize screen zones for these wells.

Quarterly rounds of ground water sampling and analysis are proposed for the Phase 2 RI/FS (Table 3). Ground water elevations will be gauged concurrent with sampling. Ground water samples will be collected using the USEPA Region II Low Flow methodology. In order to establish the relationship between new data and historical results, several wells will also be sampled using conventional methods, as was used in prior sampling events. These comparability tests are intended to provide a basis for evaluating temporal changes in ground water quality through the use of existing data.

- Activity 4b - Aquifer Testing - Aquifer testing of both the Upper PRM and Upper Middle PRM aquifers will be performed with the following objectives:
 - + calculate the aquifers properties and determine the hydraulic connection and interaction between the Upper PRM and the Upper Middle PRM aquifers;
 - + assess the efficacy of pumping for containment purposes;
 - + further assess the hydraulic gradients beneath the former lagoon;
 - + assess the potential for ground water extraction to affect the neighboring wetlands adjacent to the BROS property;
 - + evaluate the feasibility of ground water extraction as a remedial alternative, including an evaluation of the affect of pumping on the local and regional water budget (including ground water extraction at the CLTL site);
 - + provide the information needed to evaluate the volumes of ground water withdrawal needed for hydraulic control of the areas with residual LNAPL on the BROS property; and
 - + evaluate the potential for aquifer clean up.

- Activity 5 - Surface Water and Sediment Quality Evaluation –
 - Activity 5a - Gaventa and Swindell Ponds - Surface water and sediment samples will be collected from the northeast corner of Gaventa Pond (Tables 2 and 3) and the northern portion of Swindell Pond. The northeast corner of Gaventa Pond is closest to the former BROS lagoon and was previously identified to have a sheen. Three surface water samples and eight sediment samples will be collected from Gaventa Pond for laboratory analysis (Figure 9). Previous investigations have indicated the presence of elevated concentrations of COPCs in northern portion of Swindell Pond. Three surface water samples and three sediment samples (Tables 2 and 3) will be collected from Swindell Pond for laboratory analysis (Figure 9).
 - Activity 5b - Little Timber Creek, Little Timber Creek Swamp and Cedar Swamp - Soil/sediment samples will be collected to characterize the concentration gradients of COPECs extending out from areas with residual LNAPL (Tables 2 and 3). Surface water samples will be used to determine the mobility of the residual contaminants. In addition, the sampling results will also serve as inputs to the human health and ecological risk assessment. Twenty-two surface water, 61 soil/sediment and 12 shallow ground water sampling locations are planned for Little Timber Creek and the swamp area to the east of the former BROS Lagoon between Routes I-295 and 130 and to the north of U.S. Route 130 (Figure 10). In addition, five surface water and 15 sediment sampling locations are planned for the five proposed reference areas. The sampling locations are depicted on recent aerial photographs at the request of USEPA during the initial scoping process. This figure conveys the relationship between sampling locations and wetland features (i.e. vegetation and surface water patterns). More traditional figures will be used to convey RI results.
 - Activity 5c - Swale Along U.S. Route 130 - Surface water samples will be collected from the swale which parallels U.S. Route 130 North. The objective of the surface water sampling in the swale is to evaluate the fate and transport of COPCs; especially relative to potential background sources (e.g., highway) and the LNAPL identified in MW-L3A in the swale.
- Activity 6 - Human Health Exposure Point Concentration (EPC) Evaluation
 - Within the baseline human health risk assessment, exposure point concentrations (EPCs) may be estimated using monitoring data alone, or a combination of monitoring data and data from environmental fate and transport models. Site-specific information will be used to determine the appropriate combination of monitoring and modeling data for determining EPCs for the relevant media at the site. Site-specific data that will be collected in support of estimating EPCs include:
 - + the location, depth and uses of supply wells in the area, based upon the well survey;
 - + areas where development will be precluded due land use restrictions, based upon the wetlands delineation; and

- + the potential for land development and the likelihood that new developments will utilize public water supplies, based upon information obtained from the Logan Township Planning Office.
- Activity 7 - Ecological Evaluations
 - Activity 7a - Biological Survey - The biological survey component of the biological evaluation will include the following:
 - + general biological receptor survey;
 - + fish population evaluation;
 - + habitat (vegetation cover) evaluation; and
 - + wetland delineation.
 - Activity 7b - Biotic Assessment - The biotic assessment of the ecological evaluation will be phased and will include the following:
 - + comparison of the species composition of several communities with reference sites;
 - + determination of aquatic macroinvertebrate densities and abundance; and
 - + collection and chemical characterization of tissue from measurement endpoints, selected after the biological survey.

Task IIIB - Data Analysis

- The processes of data validation, data reduction, data evaluation, and environmental fate and transport modeling are grouped under data analysis. After the initial comprehensive ground water sampling round, a CEA proposal will be presented to the NJDEP for the area where the concentrations of site-related contaminants currently exceed, or will exceed, the New Jersey GWQC at N.J.A.C. 7:9-6. The magnitude of COPC transfer among site media will be evaluated in order to estimate transport mechanics between soil and ground water. The evaluation will be based on data collected during Task III activities and will address transport from unsaturated soil/sediments to surface water. Detailed analysis of specific components of the conceptual model will be completed through numerical ground water flow, fate and transport modeling and surface-water modeling performed during the remedial investigation. The modeling will be conducted to support the risk assessment and evaluation of remedial alternatives.

Task IIIC - Data Management Procedures

- Data management procedures include the documentation and sample management procedures detailed in the QAPP.

Task IIID - Site Characterization Deliverables

- A Site Characterization Summary Report will be submitted to the USEPA after completion of the field sampling and analysis. The Site Characterization Summary Report will condense the investigative activities that have taken place during the Phase 2 RI and present data generated which identifies the locations and characteristics of surface and subsurface features and COPCs at the site which includes the affected medium, location, types, physical state and concentrations of COPCs. To the degree appropriate, specific AOCs or "hot spots" will be defined for purposes of data analysis and presentation. The Site Characterization Summary Report will provide the preliminary reference to develop the baseline risk assessment and to evaluate the development and screening of remedial alternatives and the refinement and identification of ARARs.

Task IV - Identification of Candidate Technologies

- Candidate technologies, including innovative technologies, have been identified and evaluated as part of the RI/FS scoping activities. These technologies will be reviewed as data collection proceeds to identify a range of technologies required for alternative analysis.

Task V - Treatability Studies

- After the Phase 2 RI data collection has begun, the need for and scope of treatability studies will be identified in a Technical Memorandum to USEPA. Following USEPA approval of the Technical Memorandum, the testing will be conducted and the results used in the evaluation of remedial alternatives.

Task VI - Baseline Risk Assessment

- Determine the risks posed by any remaining contamination at the site to human and ecological receptors at the site. Results are used in the feasibility study to focus remedial alternatives on the principal risks and provide the basis to calculate the probable risk reductions associated with remedial alternatives as well as the risks posed by the alternatives (USEPA, 1998f).

Task VIA- Human Health Risk Assessment

- The *Baseline Risk Assessment* will be conducted in multiple steps. It will include as an interim deliverable the Exposure Pathway Analysis Report which will be presented in the

form of a Technical Memorandum. The five phases of the risk assessment as described in RAGS Part A (USEPA, 1989) are data collection; data evaluation; exposure assessment; toxicity assessment; and risk characterization. These phases are discussed in more detail in the Work Plan. The three basic parts of the RI/FS human health evaluation that will be completed are:

- Part A – Baseline Risk Assessment (USEPA, 1989);
- Part B – Refinement of risk-based Preliminary Remedial Goals (USEPA, 1991a); and
- Part C – Evaluation of remedial alternative risk (USEPA, 1991b).

Task VIB - Ecological Risk Evaluation

- The ecological risk evaluation process under CERCLA is comprised of eight steps and several scientific/management decision points (SMDPs) (USEPA, 1997). SMDPs are significant communication points which function to focus the ERA as more information becomes available and evaluate the need for reductions in uncertainties. Each SMDP will be discussed with the USEPA. The eight steps are:
 - Step 1 Screening Level Problem Formulation
 - Step 2 Screening Level Exposure Estimate and Risk Calculation
 - Step 3 Baseline Risk Assessment Problem Formulation
 - Step 4 Study Design and Data Quality Objectives Process
 - Step 5 Verification of Field Sampling Plan
 - Step 6 Site Investigation and Data Analysis
 - Step 7 Risk Characterization

Task VII - Draft Remedial Investigation Report

- Summarizes the field activities and findings which characterize the site and includes the human health and ecological risk assessments.

Task VIII - Development of Remedial Action Objectives and Screening of Remedial Alternatives

- The development and screening of remedial alternatives is performed to develop an appropriate range of risk and waste management options that will be evaluated. This range of alternatives will include as appropriate, options in which treatment is used to reduce the toxicity, mobility, or volume of wastes, but varying in the types of treatment, the amount treated, and the manner in which long-term residuals or untreated wastes are

managed; options involving containment with little or no treatment; options involving both treatment and containment; and a no-action alternative.

Task VIIIA - Development and Screening of Remedial Alternatives

Task VIIIB - Conduct and Document Screening Evaluation of Each Alternative

Task VIIC - Presentation of Remedial Action Objectives and Development and Screening Alternatives

Task IX - Feasibility Study Report

- The final RI/FS task is the detailed analysis of alternatives which is conducted through the application of nine evaluation criteria to the assembled remedial alternatives. The approach will ensure that the selected remedial alternative(s) will be protective of human health and the environment; will be in compliance with, or include a waiver of, ARARs; will be cost-effective; will utilize permanent solutions and alternative treatment technologies, or resource recovery technologies, to the maximum extent practicable; and will address the statutory preference for treatment as a principal element, taking into account the treatment already completed at the site. The evaluation criteria include: (1) overall protection of human health and the environment; (2) compliance with ARARs; (3) long-term effectiveness and permanence; (4) reduction of toxicity, mobility, or volume; (5) short-term effectiveness; (6) implementability; (7) cost; (8) state (or support agency) acceptance; and (9) community acceptance. (Note: Criteria 8 and 9 are considered after the Phase 2 RI/FS report has been released to the general public.)

Upon completion, a draft FS report will be submitted to USEPA for review and approval. Once USEPA's comments have been addressed by the Defendants to USEPA's satisfaction, the final FS report will be bound with the final RI report.

Task IXA - Detailed Analysis of Alternatives

- The detailed analysis will include a comparative analysis of the remedial alternatives in which each alternative will be compared against the others using the evaluation criteria as a basis of comparison. Identification and selection of the preferred alternative(s) will be completed by the USEPA.

Task IXB - Detailed Analysis Deliverables

Schedule

A detailed schedule for the Phase 2 RI/FS has been prepared consistent with the EPA-approved schedule (see Plate 1 of the QAPP). The overall project schedule is predicated on receipt of USEPA approval of this revised Phase 2 RI/FS Work Plan (and the QAPP, SAP and HASP) by January 1999. An additional two months are projected for completion of a public meeting to provide for public participation in the Phase 2 RI/FS scoping process.

The overall schedule is driven by the seasonal sensitivity of the aquifer pumping tests and ecological risk assessment (ERA) field data collection efforts. Specifically, the aquifer tests should be performed during the driest period of the year, late summer, to provide a basis for predicting the influence of ground water extraction on the wetlands. Information from the CLTL extraction system and available regional hydrology data can then be used for the conceptual design of a pumping system that will be effective during wetter periods. This information will be used for the design and evaluation of remedial alternatives.

Based on USEPA comments, the ERA data collection must be conducted during two periods representing both wet and dry conditions in the wetland areas. As such, data collection will be completed in two phases, one between April and June, and the other between August and early October. In addition to providing both wet and dry season data, these periods correspond to the time when tree canopy cover is established, juvenile amphibians have matured to identifiable life stages, winter migrants have returned and the maximum numbers of aquatic macroinvertebrates are present.

An advantage of the proposed schedule is that it provides for subsequent phases of the RI delineation efforts, to the extent necessary. Subsequent phases of RI field work can be more readily accommodated if Work Plan approval occurs by January 1999.

Completion of the work in accordance with the schedule will be dependent upon the following:

- the timing of the USEPA approval of the Phase 2 RI/FS Work Plan (and the Quality Assurance Plan, Sampling and Analysis Plan, and Health and Safety Contingency Plan);
- obtaining access to properties for sampling;
- review, comment, and approval periods for the interim project deliverables (e.g. technical memoranda) throughout the process;
- the flexibility in the schedule to conduct aquifer pumping tests and ecological risk evaluations during late summer when the general data will be most decision relevant; and
- the need for any subsequent phases of field investigation to complete the RI, especially the ecological risk evaluation of Little Timber Creek.

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- USEPA, 1997. *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments*. Interim Final. U.S. Environmental Protection Agency, Environmental Response Team, Edison, NJ
- USEPA, 1998. *Risk Assessment Guidance for Superfund: Volume I: Human Health Evaluation Manual. Part D. Standardized Planning, Reporting and Review of Superfund Risk Assessments*. Interim. Publication 9285.701D. January 1998.

Table 1. Justification and Boring Depths for Proposed Soil and Sediment Sampling Locations. BROS Phase 2 RI/FS; Bridgeport, New Jersey.

Activity Number and Description	Boring Number	Proposed Depth Interval (Ft. BGS)	Justification
2b - Former Lagoon Area	L-1, L-2, L-7, L-8 L-3 through L-6	60 100	Evaluate the stratigraphy of the lagoon area, including the presence of a confining and/or peat layer and the distribution and characteristics of chemical residuals, below the former lagoon, remaining after initial remedial activities, including screening for DNAPL.
	L-9A through L-16B	40	Evaluate the stratigraphy of the soils surrounding the lagoon, including the presence of a confining and/or peat layer and the distribution and characteristics of chemical residuals remaining around the former lagoon after initial remedial activities, including screening for DNAPL.
2b - Former Process Area	P-20	40	Evaluate the stratigraphy (clay/peat) and COPC concentrations to the west of the lagoon. Gives coverage between proposed borings L-15B and L-16B.
	P-21	40	Evaluate the stratigraphy (clay/peat) and COPC concentrations to the west of the lagoon. Evaluate the extent of product encountered in USEPA borings B-1 and B-2.
	P-22	40	Evaluate the stratigraphy (clay/peat) and COPC concentrations to the north of the lagoon including chlorinated VOCs which were not analyzed in nearby USEPA boring SB-18, which had elevated concentrations of BTEX.
	P-23	40	Evaluate the stratigraphy (clay/peat) and COPC concentrations to the north of the lagoon including chlorinated VOCs and the extent of product encountered in USEPA boring B-1 and B-2.
	P-24	40	Evaluate the stratigraphy (clay/peat) and COPC concentrations to the north of the lagoon including chlorinated VOCs, which were not analyzed in nearby USEPA boring B-7, which had elevated concentrations of BTEX, and the extent of product encountered in USEPA boring B-33.
	P-25	40	Evaluate the stratigraphy (clay/peat) and COPC concentrations to the north of the lagoon including chlorinated VOCs and the extent of product encountered in USEPA boring B-6.
	P-26	40	Evaluate the stratigraphy (clay/peat) and COPC concentrations to the north of the lagoon including chlorinated VOCs in an area where soil borings were not previously installed.
	P-27	40	Evaluate the stratigraphy (clay/peat) and COPC concentrations to the north of the lagoon including chlorinated VOCs and the extent of product encountered in USEPA boring B-32.
	P-28	40	Evaluate the stratigraphy (clay/peat) and COPC concentrations to the north of the lagoon including chlorinated VOCs.
	P-29	40	Evaluate the stratigraphy (clay/peat) and COPC concentrations to the north of the lagoon including chlorinated VOCs in an area where soil borings were not previously installed.
	P-30	40	Evaluate the stratigraphy (clay/peat) and COPC concentrations to the north of the Former Process and Tank Areas and extent of product encountered in the drainage ditch (MW-13A).
	P-31	40	Evaluate the stratigraphy (clay/peat) and COPC concentrations to the north of the Former Process and Tank Areas and the extent of product encountered in the drainage ditch (MW-13A).

⁽¹⁾The soil borings will be continued six inches into the first inorganic layer.

Table 1. Justification and Boring Depths for Proposed Soil and Sediment Sampling Locations. BROS Phase 2 RI/FS; Bridgeport, New Jersey.

Activity Number and Description	Boring Number	Proposed Depth Interval (Ft. BGS)	Justification
	P-32	40	Evaluate the stratigraphy (clay/peat) and COPC concentrations to the north of the lagoon including chlorinated VOCs which were not analyzed in nearby USEPA boring SB-19, which had elevated BTEX concentration.
	P-33	40	Evaluate the stratigraphy (clay/peat) and COPC concentrations to the north of the Former Process and Tank Areas and the extent of product encountered in the drainage ditch (MW-13A).
	P-34	40	Evaluate the stratigraphy (clay/peat) and COPC concentrations to the north of the lagoon including chlorinated VOCs.
	P-35	40	Evaluate the stratigraphy (clay/peat) and COPC concentrations to the north of the Former Process and Tank Areas and the extent of product encountered in the drainage ditch (MW-13A).
	P-36	40	Evaluate the stratigraphy (clay/peat) and COPC concentrations to the north of the lagoon including chlorinated VOCs which were not analyzed in nearby USEPA boring S45Y-1, which had elevated BTEX concentrations.
	P-37	40	Evaluate the stratigraphy (clay/peat) and COPC concentrations to the north of the lagoon including chlorinated VOCs.
	P-38	40	Evaluate the stratigraphy (clay/peat) and COPC concentrations to the north of the lagoon including chlorinated VOCs in an area where soil borings were not previously installed.
	P-39	40	Evaluate the stratigraphy (clay/peat) and COPC concentrations to the north of the lagoon including chlorinated VOCs in an area where soil borings were not previously installed.
	P-40	40	Evaluate the stratigraphy (clay/peat) and COPC concentrations to the north of the lagoon including chlorinated VOCs in an area where soil borings were not previously installed.
	P-41	40	Evaluate the stratigraphy (clay/peat) and COPC concentrations to the north of the lagoon including chlorinated VOCs in an area where soil borings were not previously installed.
	P-42	40	Evaluate the stratigraphy (clay/peat) and COPC concentrations to the north of the lagoon including chlorinated VOCs in an area where soil borings were not previously installed.
	P-43	40	Evaluate the stratigraphy (clay/peat) and COPC concentrations to the north of the lagoon including chlorinated VOCs and the extent of product encountered in USEPA boring B-27.
	P-44	40	Evaluate the stratigraphy (clay/peat) and COPC concentrations to the north of the lagoon including chlorinated VOCs and the extent of product encountered in USEPA boring B-30 and B35MM-1.
	PB-1 through PB-5	10	Evaluate concentrations of COPCs in soil and the presence of NAPL in the vicinity of the Pepper Building.

⁽¹⁾The soil borings will be continued six inches into the first inorganic layer.

Table 1. Justification and Boring Depths for Proposed Soil and Sediment Sampling Locations. BROS Phase 2 RI/FS; Bridgeport, New Jersey.

Page 3 of 3

Activity Number and Description	Boring Number	Proposed Depth Interval (Ft. BGS)	Justification
4a - Monitoring Well Installation	MW-24S, MW-25S, MW-28S, MW-29S, MW-30S, MW-31S, MW-32S	15	Evaluate the stratigraphy of the Cape May Formation and the Upper PRM and determine if NAPL is present below table water.
	PZ-1 AND PZ-2	10	Evaluate the stratigraphy of the soils below the base of Gaventa and Swindell Pond; evaluate the geotechnical properties of the soil and to determine if a clay layer is present below the water bodies.
	MW-4D, MW-18D, MW-20D through MW-23D, MW-26D, MW-27D	60-160	Evaluate the stratigraphy of the Upper and Middle PRM and to determine if confining layers are present between the Upper and Middle PRM and between the Upper-Middle and Lower-Middle PRM.
5a - Gaventa and Swindell Ponds	GVT-1 through GVT-8	0.5	Evaluate the distribution and gradients of COPCs in the sediments of Gaventa Pond.
	SWD-1 through SWD-3	0.5	Evaluate the distribution and gradients of COPCs in the sediment in Swindell Pond.
5b - Little Timber Creek and Swamp	LTC-1 through LTC 61	TBD ⁽¹⁾	Characterize the de manifestis, intermediate and de minimis zone boundaries; establish gradients of COPCs, characterize the distribution of NAPL in the de manifestis zones, characterize the physical and chemical properties of the wetlands.
	R-1 through R-15	TBD ⁽¹⁾	Reference area samples to establish background concentrations of COPCs and to support the ecological risk assessments.

⁽¹⁾The soil borings will be continued six inches into the first inorganic layer.

Table 2. Justification and Screened Intervals for Proposed Monitoring Wells. BROS Phase 2 RI/FS; Bridgeport, New Jersey.

Well No.	Proposed Screen Interval (ft BGS)	Aquifer	Justification
MW-4D	105-115	Base of Upper Middle PRM	Determine presence/absence of DNAPL; Determine COPCs at base of Upper Middle PRM; Flux calculations
MW-17D through MW-19D and MW-33D and MW-34D	150-160	Base of Upper Middle PRM	Delineation of COPCs south of Route 295
MW-20D	80-90	Base of Upper Middle PRM	Evaluate western extent of VOCs; Determine upgradient conditions for model calibration
MW-21S	5-15	Upper PRM	Delineation of VOC gradient between Route 130 and Route 295; Evaluate horizontal contaminant gradient away from former lagoon; Evaluate vertical gradients beneath wetlands; Calibrate flow model; Key monitoring wells for pumping test; Obtain geochemical data
MW-21L	30-40	Base of Upper PRM	
MW-21I	50-60	Top of Upper Middle PRM	
MW-21D	120-130	Base of Upper Middle PRM	
MW-22S	5-15	Upper PRM	Delineation of VOC gradient between Route 130 and Route 295; Evaluate horizontal contaminant gradient away from former lagoon; Evaluate vertical gradients beneath wetlands; Calibrate flow model; Key monitoring wells for pumping test; Obtain geochemical data
MW-22L	30-40	Base of Upper PRM	
MW-22I	50-60	Top of Upper Middle PRM	
MW-22D	110-120	Base of Upper Middle PRM	
MW-23S	5-15	Upper PRM	Characterize surface-water/ground-water relationship between Swindell Pond and aquifer; Calibrate model; Flux calculations
MW-23I	40-50	Top of Upper Middle PRM	
MW-23D	95-105	Base of Upper Middle PRM	
MW-24S	5-15	Upper PRM	Evaluate LNAPL south of Pepper Building
MW-25S	5-15	Upper PRM	Evaluate LNAPL in swale north of former tank farm
MW-26S	20-30	Upper PRM	Evaluate ground-water conditions within and below former lagoon; Determine continuity of clay layer immediately underlying lagoon; Determine presence/absence of LNAPL; Determine presence/absence of DNAPL; Calibrate model; Flux calculations
MW-26I	45-55	Top of Upper Middle PRM	
MW-26D	90-100	Base of Upper Middle PRM	
MW-27S	20-30	Upper PRM	Evaluate ground-water conditions within and below former lagoon; Determine continuity of clay layer immediately underlying lagoon; Determine presence/absence of LNAPL; Determine presence/absence of DNAPL; Calibrate model; Flux calculations
MW-27I	45-55	Top of Upper Middle PRM	
MW-27D	90-100	Base of Upper Middle PRM	

Table 2. Justification and Screened Intervals for Proposed Monitoring Wells. BROS Phase 2 RI/FS; Bridgeport, New Jersey.

Well No.	Proposed Screen Interval (ft BGS)	Aquifer	Justification
MW-28S	5-15	Upper PRM	Determine if Pepper Building area is source of COPCs in ground-water contamination detected north of Route 130
MW-29S	5-15	Upper PRM	Evaluate LNAPL between former process area and wells MW-1A and S11A
MW-30S through MW-32S	5-15	Upper PRM	Delineate potential LNAPL in former process area; Evaluate ground-water quality in former process area
PZ-1	20-30	Upper PRM ⁽¹⁾	Characterize surface-water/ground-water relationship between Gaventa Pond and former lagoon; Calibrate model; Flux calculations
PZ-2	20-30	Upper PRM ⁽¹⁾	Characterize surface-water/ground-water relationship between Swindell Pond and aquifer; Calibrate model; Flux calculations
WMW-1 through WMW-6	1-3/4-6 ⁽²⁾	Upper PRM	Evaluate vertical flow gradients in Little Timber Creek Swamp; Determine ground-water quality with depth; Supplement water budget data

Notes:

⁽¹⁾If there is no appreciable thickness of the Upper PRM below the base of the ponds then the well screens will be located to monitor the confining layer and/or the top of the Upper Middle PRM aquifer.

⁽²⁾A pair of monitoring wells constructed by alternative methods; one screened from 1-3 ft BGS and one screened from 4-6 ft BGS.

VOC = Volatile organic compounds

DNAPL = Dense non-aqueous phase liquids

LNAPL = Light non-aqueous phase liquids

ft BGS = Feet below ground surface

COPCs = Constituents of potential concern

Table 3. Analytical Parameters for Ground Water and Surface Water. BROS Phase 2 RI/FS; Bridgeport, New Jersey.

Activity # and Description	Sample Designation	Number of Sampling Points	TCL Volatile Organic Compounds	TCL Semivolatile Organic Compounds	TCL Base Neutrals	Polychlorinated Biphenyls	Total Petroleum Hydrocarbons	TAL Metals	Alkalinity	Total Suspended Solids	Total Dissolved Solids	Sulfate/Sulfide	Nitrate/Nitrite/Ammonia	Chloride	Silica	Orthophosphate	Chemical Oxygen Demand	Total Kjeldahl Nitrogen	Total Organic Carbon	Dissolved Oxygen*	Hardness	El/pH/specific conductance/temperature*	Ferrous Iron*	Methane, Ethene, Ethane	Organic Acids	Waste Classification ⁽¹⁾	Carbon Dioxide	Hydrogen Sulfide	Dissolved Iron
1b - Evaluation of Ground Water Use On and Around the Site	To be determined																												
4a - Ground-Water Quality Evaluation	MW-170 through MW-19D, MW-33D, MW-34D	5	✓ ⁽¹⁰⁾																										
	MW-170 through MW-19D, MW-33D, MW-34D	5	✓																										
	First round ⁽²⁾	42	✓ ⁽⁹⁾	✓				✓ ⁽⁵⁾	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓
	Second round ⁽³⁾	56	✓ ⁽⁹⁾		✓			✓ ⁽⁵⁾	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓
	Third round ⁽⁴⁾	20	✓ ⁽⁹⁾																			✓	✓	✓				✓	✓
	Fourth round ⁽⁴⁾	20	✓ ⁽⁹⁾																		✓		✓	✓					
5b - Little Timber Creek Surface Water Quality Evaluation	LTC-1 through LTC-6 LTC-12 through LTC-13 LTC-51 through LTC-55 LTC-58 through LTC-61	22	✓	✓ ⁽⁶⁾		✓ ⁽⁶⁾	✓	✓ ⁽⁶⁾	✓	✓ ⁽⁷⁾	✓ ⁽⁷⁾	✓ ⁽⁷⁾	✓ ⁽⁷⁾	✓ ⁽⁷⁾				✓ ⁽⁷⁾	✓ ⁽⁶⁾		✓ ⁽⁷⁾	✓	✓ ⁽⁷⁾						
Background/Reference Wetland Surface Water Quality Evaluation	R-2, R-5, R-3, R-4	4	✓	✓ ⁽⁶⁾		✓ ⁽⁶⁾	✓	✓ ⁽⁶⁾	✓	✓ ⁽⁷⁾	✓ ⁽⁷⁾	✓ ⁽⁷⁾	✓ ⁽⁷⁾	✓ ⁽⁷⁾				✓ ⁽⁷⁾	✓ ⁽⁶⁾		✓ ⁽⁷⁾	✓	✓ ⁽⁷⁾						
5a - Gaventa and Swindell Pond Surface Water Quality Evaluation	GVT-1 through GVT-3	3		✓			✓	✓	✓	✓	✓								✓	✓	✓	✓	✓						
	SWD-1 through SWD-3	3		✓			✓	✓	✓	✓	✓								✓	✓	✓	✓	✓						
5c - Swale along Route 130	SWL-1 and SWL-2	2	✓	✓ ⁽⁶⁾		✓ ⁽⁶⁾	✓ ⁽⁶⁾	✓ ⁽⁶⁾																					

* = Measured in the field.

⁽¹⁾ Analysis of investigation derived wastes for the following parameters for waste disposal classification: Volatile organic compounds, semivolatile organic compounds, metals, pesticides/herbicides, total polychlorinated biphenyls, ignitability, corrosivity and reactivity.

⁽²⁾ First round monitoring wells = All existing MW designated wells (30 wells) plus S-1A, S-1B, S-1C, S-2A, S-2C, S-3A, S-3C, S-4, S-6, S-11A, S-11C, EPA-107 and EPA-108.

⁽³⁾ Second round monitoring wells = MW-1A, S-2C, S-3C, MW-5B, MW-7A, MW-8A, MW-8B, MW-10B, S-11A, MW-11B, MW-11C, MW-13-A, and MW-14B plus all new monitoring wells.

⁽⁴⁾ Third and fourth round monitoring wells = MW-1A, S-2C, S-3C, MW-5B, MW-7A, MW-8A, MW-8B, MW-10B, S-11A, MW-11B, MW-11C, MW-13A, MW-14B, MW-18D, MW-20D, MW-21D, MW-22D, MW-23D, MW-24S, MW-25S, MW-33D and MW-34D plus intermediate depth wells to be determined based on second round results.

⁽⁵⁾ Monitoring wells MW-26S, MW-26I, MW-26D, MW-27S, MW-27I, MW-27D, MW-29S, MW-1A, and S-11A to be analyzed for dissolved metals, as appropriate.

⁽⁶⁾ Also analysis of dissolved constituents.

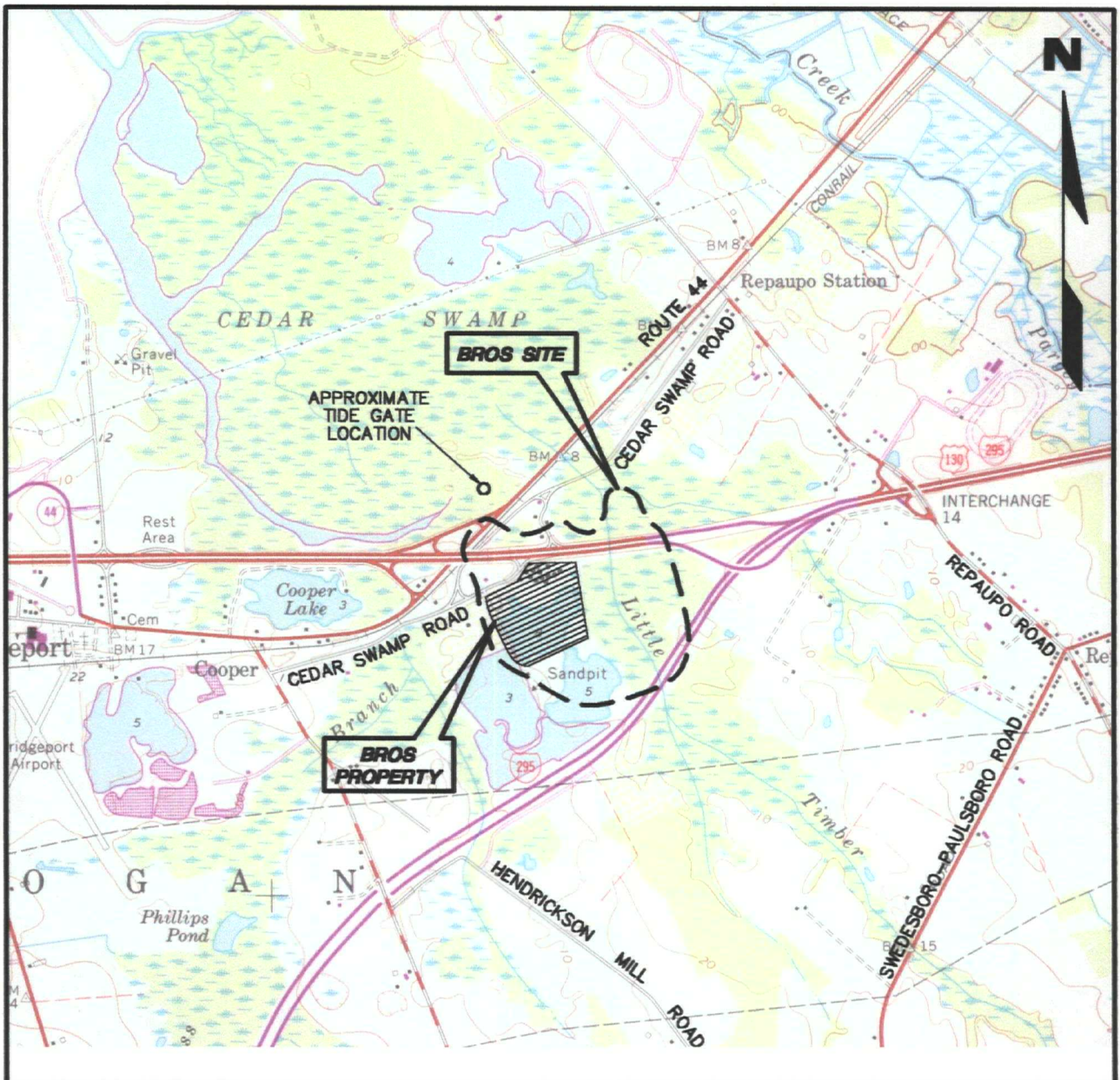
⁽⁷⁾ 50 percent of the samples collected will be analyzed for this parameter.

⁽⁸⁾ Total organic carbon samples will be field filtered to approximate dissolved organic carbon.

⁽⁹⁾ All monitoring wells samples will be collected using the low flow sampling methods; however, a percentage of monitoring well samples will be collected using conventional purge and sampling methods for comparability analysis.
First round: SC-11C, MW-5B, MW-7A, MW-8A, MW-8B, MW-10B, MW-11B, MW-14B. Second and third rounds: MW-18D, MW20D, MW21D, MW-22D, MW23D, MW24S, MW-25S, MW-29S, MW-33D, MW-34D.
Subsequent rounds: 30% of the wells or 10 of the wells listed for the second and third rounds, whichever is less, if needed based upon to results of the prior rounds.

⁽¹⁰⁾ Ground water grab samples will be collected through the slotted augers at 20 foot intervals and analyzed for VOCs using a field laboratory.

⁽¹¹⁾ TCL VOCs by EPA method 500 series.



QUADRANGLE LOCATION

LEGEND

- APPROXIMATE SITE BOUNDARY
- /// APPROXIMATE PROPERTY BOUNDARY

SOURCE:

U.S.G.S. BRIDGEPORT, N.J., QUADRANGLE 1967
7.5 MINUTE SERIES (TOPOGRAPHIC)
PHOTOREVISED 1986
CONTOUR INTERVAL 10 FEET

2,000' 0' 2,000'

Title:

SITE LOCATION MAP
SHOWING THE APPROXIMATE
BROS PROPERTY AND
BROS SITE BOUNDARIES

BRIDGEPORT RENTAL & OIL SERVICES SITE
LOGAN TOWNSHIP, NEW JERSEY

Prepared For:

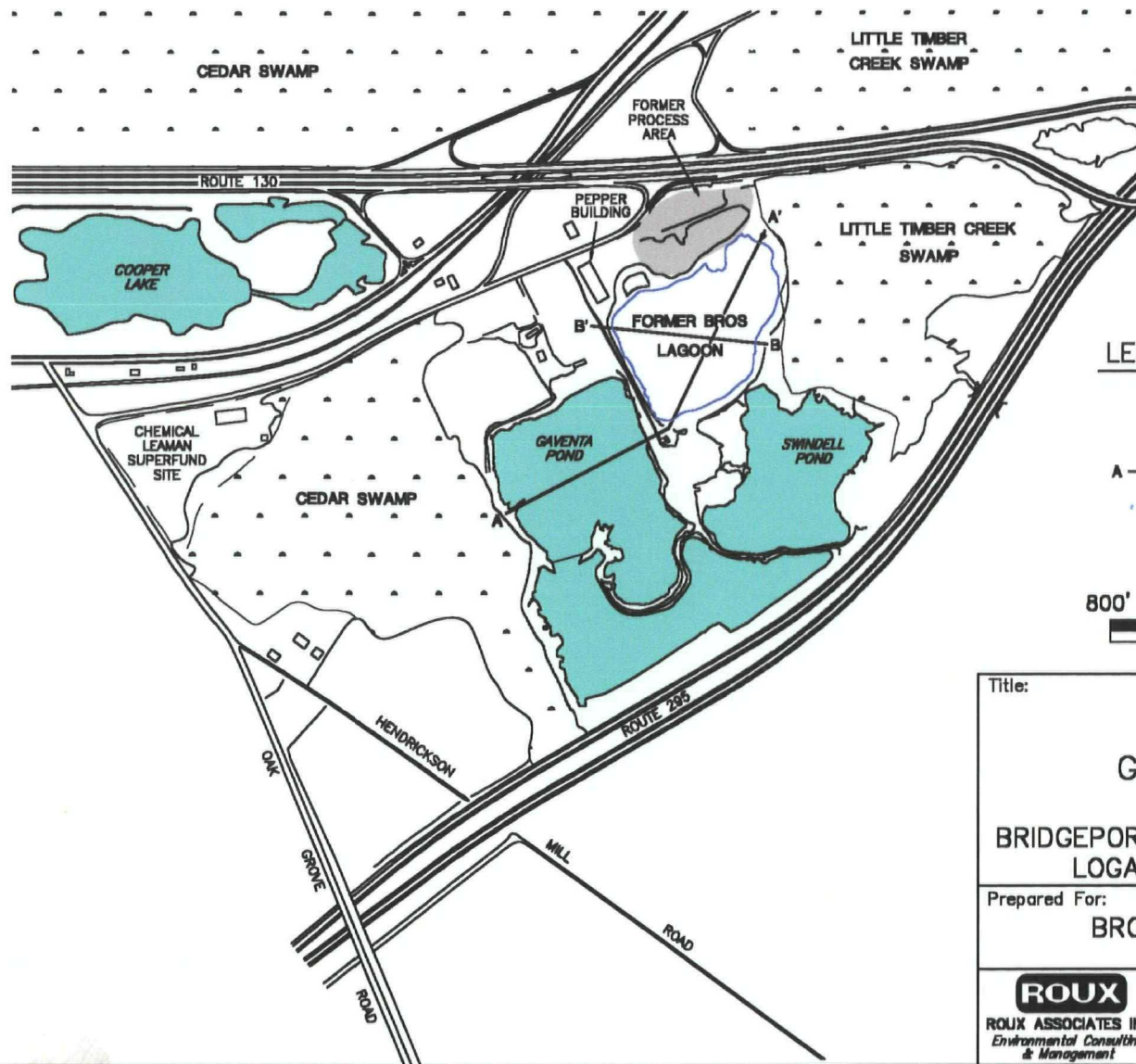
BROS TECHNICAL COMMITTEE

ROUX
ROUX ASSOCIATES INC
Environmental Consulting
& Management

Compiled by: B.G.	Date: 06/30/98
Prepared by: J.R.M.	Scale: SHOWN
Project Mgr: N.R.	Revision:
Proj No: 49301J05	File No: 49301017

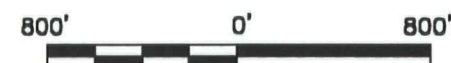
Figure
1

301221



LEGEND

- ▲ WETLANDS
- A — A' LINE OF CROSS SECTION



Title:

GENERAL SITE PLAN

BRIDGEPORT RENTAL & OIL SERVICES SITE
LOGAN TOWNSHIP, NEW JERSEY

Prepared For:

BROS TECHNICAL COMMITTEE

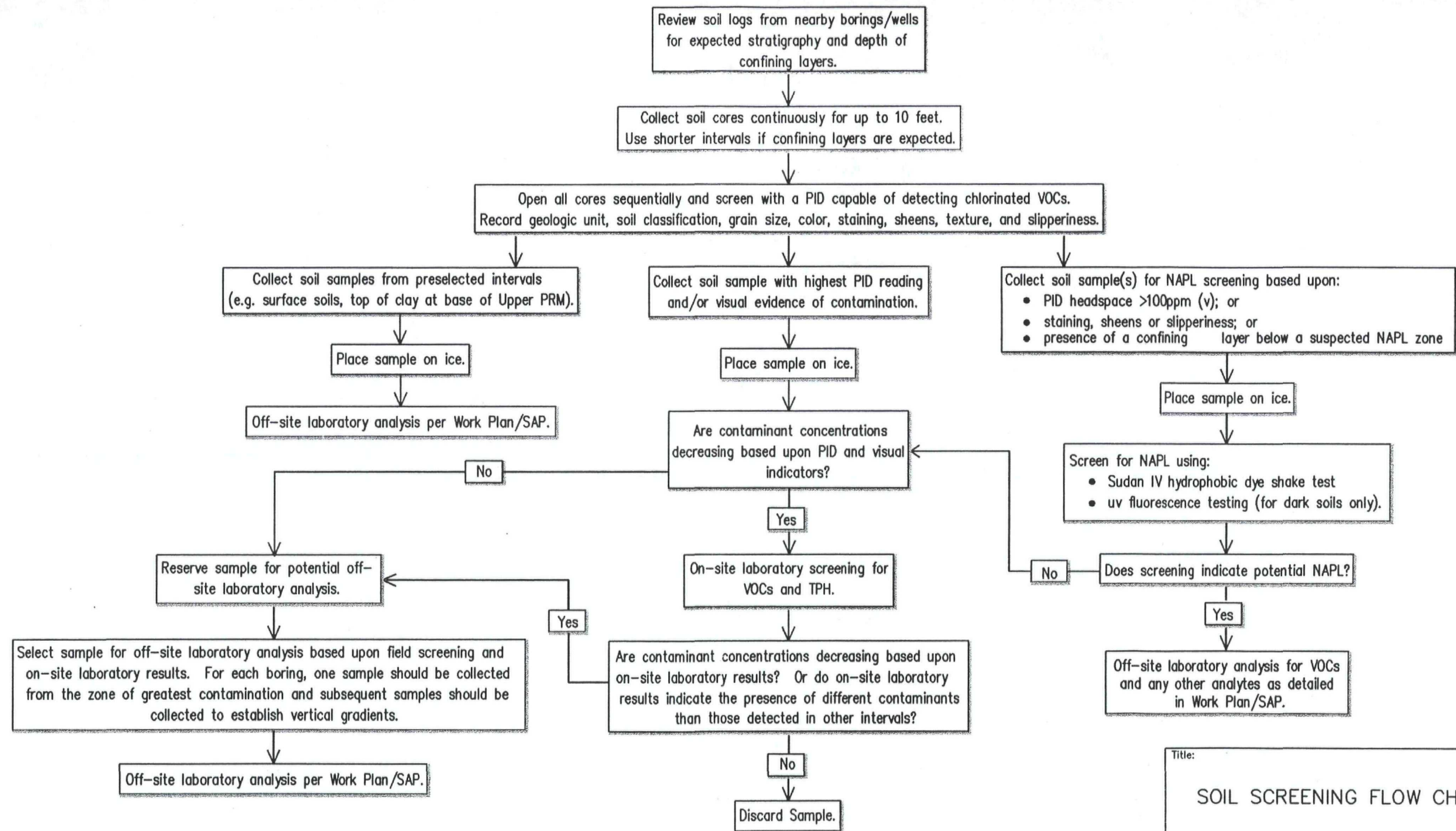
ROUX

ROUX ASSOCIATES INC
Environmental Consulting
& Management

Compiled by: B.G.	Date: 06/30/98
Prepared by: J.R.M.	Scale: SHOWN
Project Mgr: N.R.	Revision:
Proj No: 49301J05	File No: 49301023

Figure

2



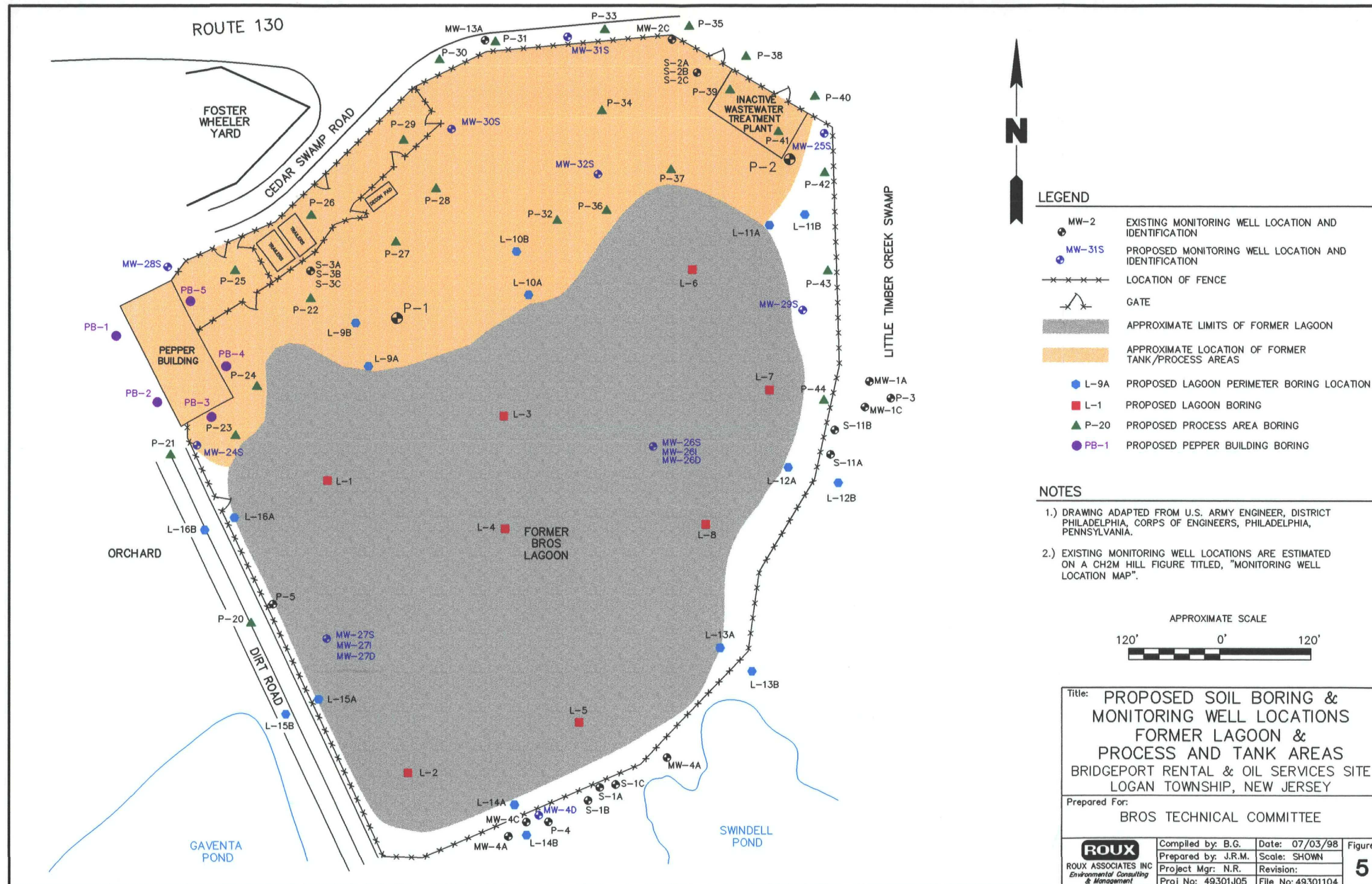
Title:

SOIL SCREENING FLOW CHART

BRIDGEPORT RENTAL & OIL SERVICES SITE
LOGAN TOWNSHIP, NEW JERSEY

Prepared For:
BROS TECHNICAL COMMITTEE

ROUX ROUX ASSOCIATES INC Environmental Consulting & Management	Compiled by: B.G.	Date: 07/03/98	Figure 4
	Prepared by: J.R.M.	Scale: N.T.S.	
	Project Mgr: N.R.	Revision:	
	Proj No: 49301J05	File No: 49301J05	





LEGEND

- ▲ MONITORING WELL CLUSTER
- ▲ EXISTING UPPER PRM MONITORING WELL
- + MONITORING WELL AND STAFF GAUGE CLUSTER
- STAFF GAUGE
- FLOW MEASUREMENT STATION

NOTES

- 1.) FM-3 AND FM-4 ARE LOCATED AT DRAINAGE CULVERTS ADJACENT TO ROUTE I-295.

SOURCE

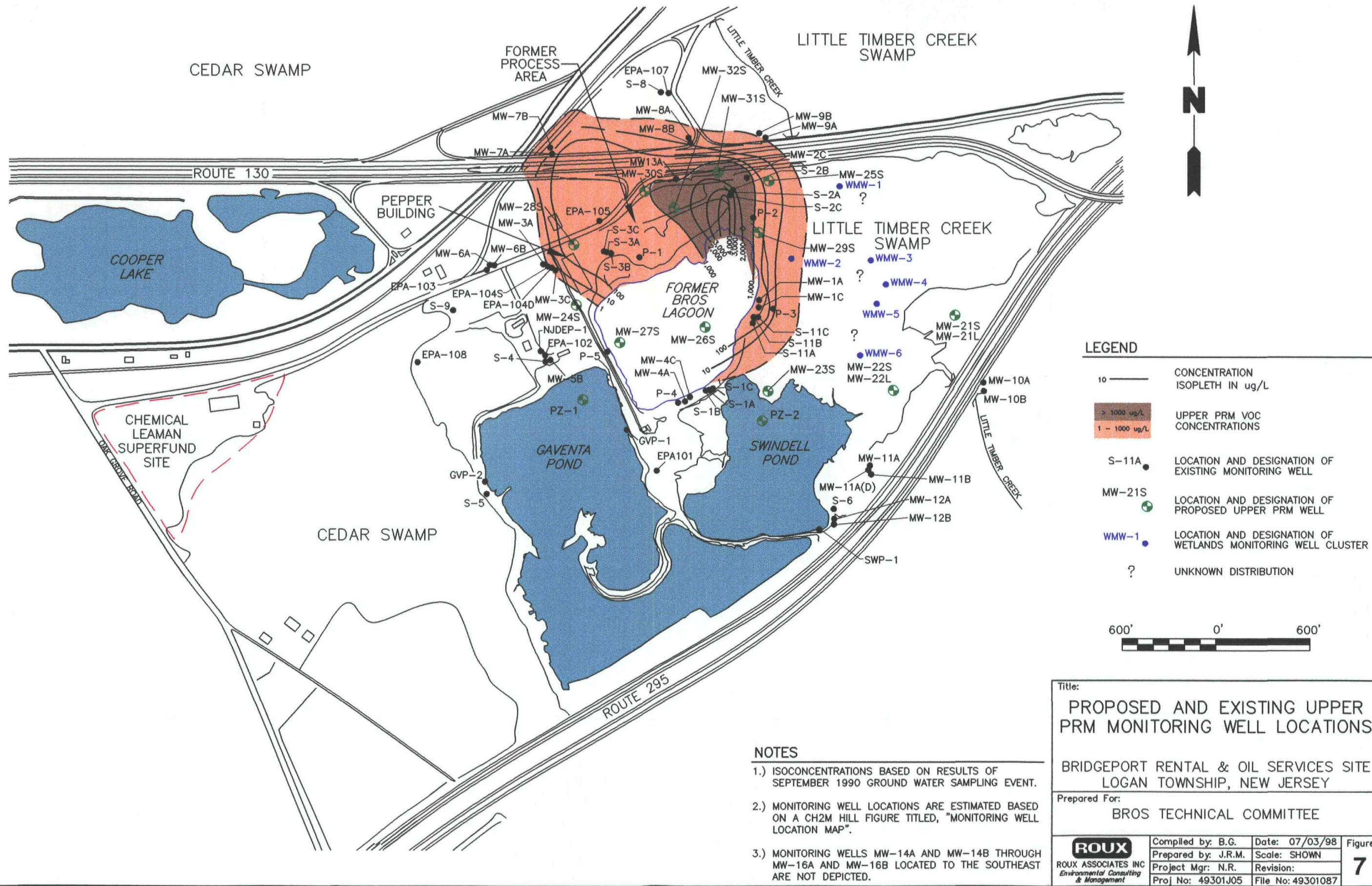
- 1.) PHOTOGRAPH TAKEN DECEMBER 29, 1994 WHEN ON-SITE INCINERATOR WAS ACTIVE.

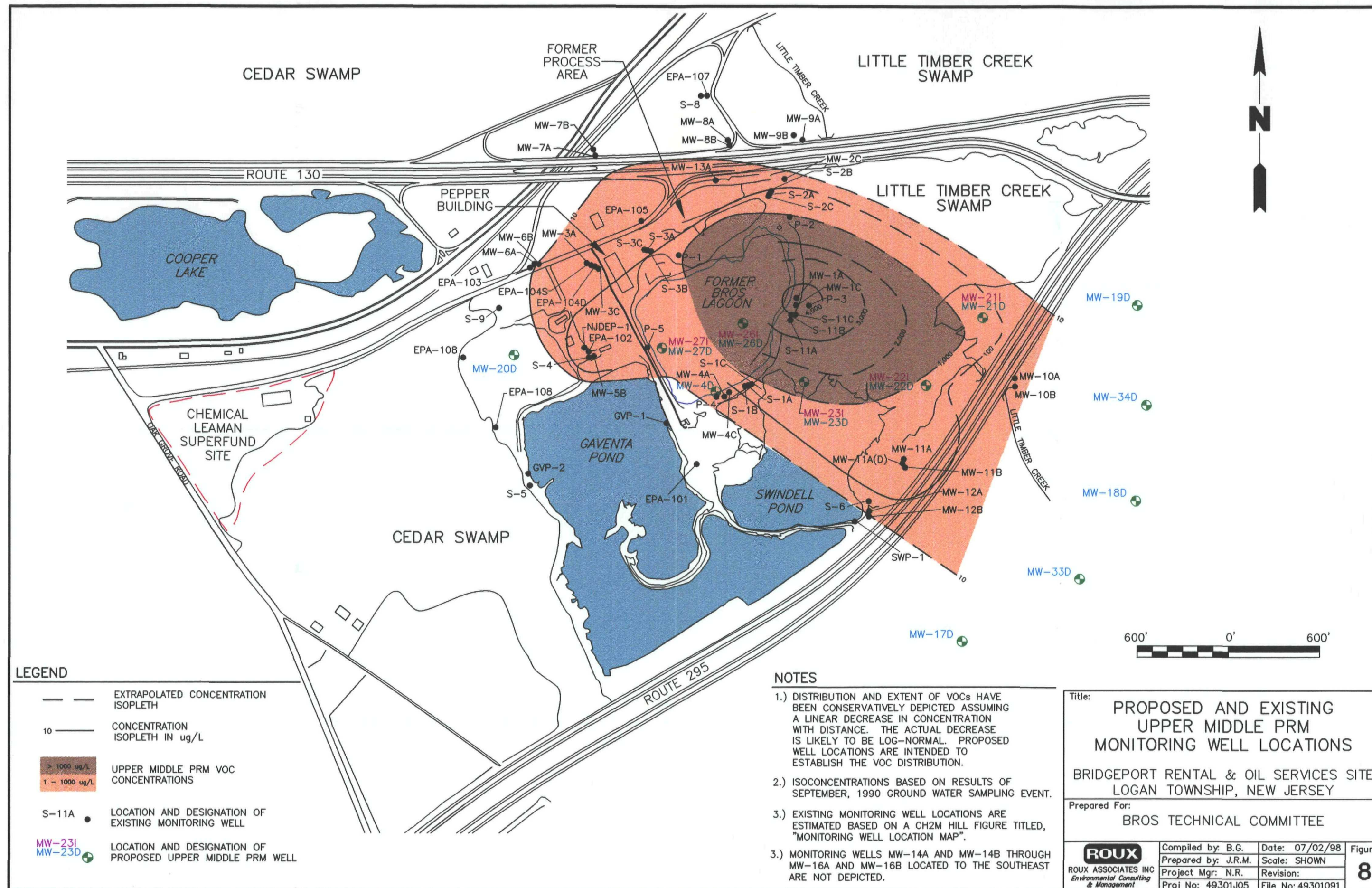
600' 0' 600'

Title: WATER BUDGET ANALYSIS
DATA POINTS FOR EVALUATION OF
SURFACE WATER AND
GROUND WATER EXCHANGE
BRIDGEPORT RENTAL & OIL SERVICES SITE
LOGAN TOWNSHIP, NEW JERSEY

Prepared For:
BROS TECHNICAL COMMITTEE

ROUX <small>ROUX ASSOCIATES INC Environmental Consulting & Management</small>	Compiled by: N.R.	Date: 12/04/98	Figure 6
	Prepared by: J.S.G.	Scale: SHOWN	
	Project Mgr: N.R.	Revision:	
	Proj No: 49301J05	File No: 49301102	







600' 0' 600'

LEGEND

- SEDIMENT SAMPLE LOCATION
- ▲ SURFACE WATER AND SEDIMENT SAMPLING LOCATION

SOURCE

1.) PHOTOGRAPH TAKEN DECEMBER 29, 1994 WHEN ON-SITE INCINERATOR WAS ACTIVE.

Title:

SAMPLING LOCATIONS FOR
GAVENTA AND SWINDELL PONDS

BRIDGEPORT RENTAL & OIL SERVICES SITE
LOGAN TOWNSHIP, NEW JERSEY

Prepared For:

BROS TECHNICAL COMMITTEE

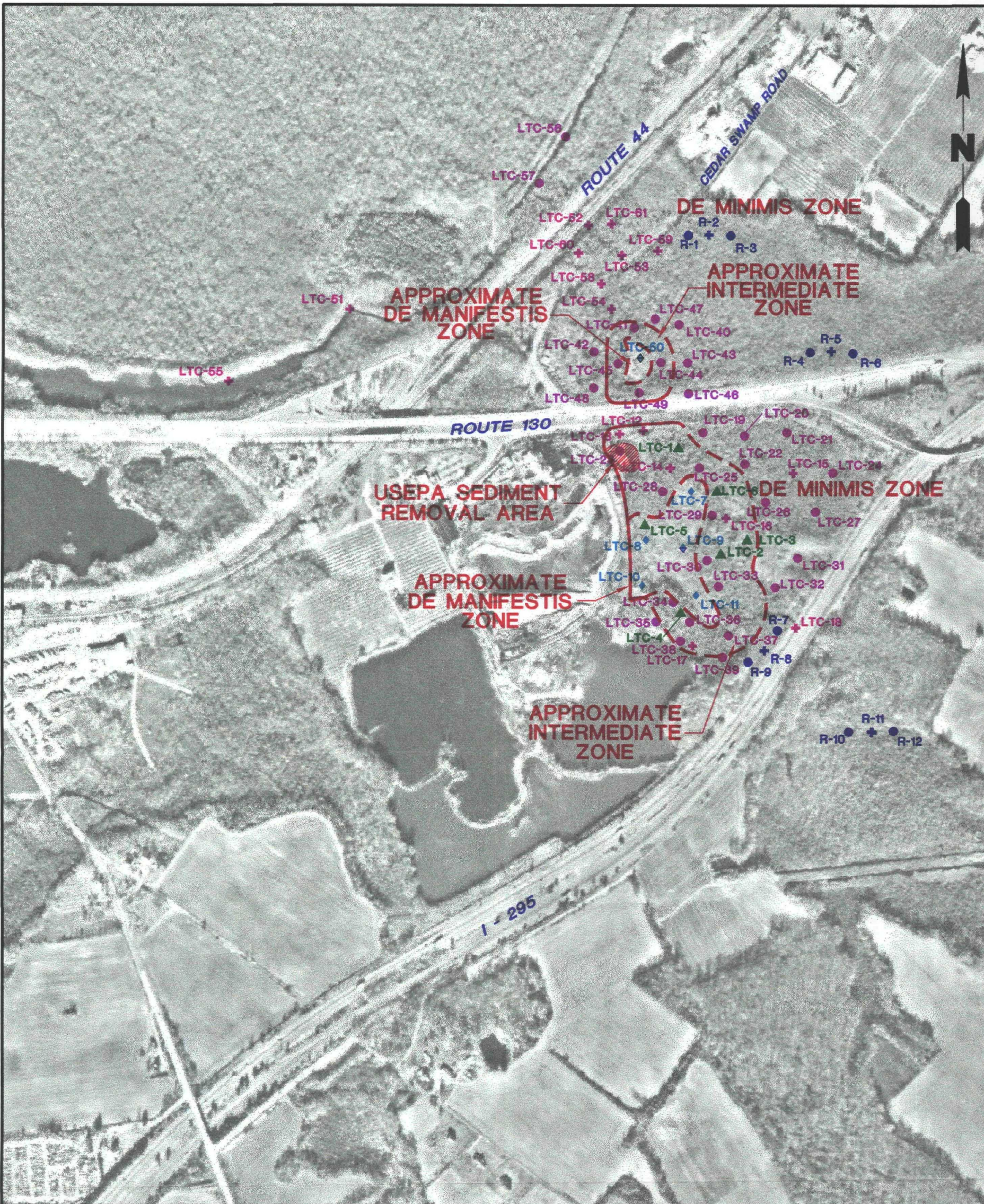
ROUX

ROUX ASSOCIATES INC
Environmental Consulting
& Management

Compiled by: N.R.	Date: 12/07/98
Prepared by: J.S.G.	Scale: SHOWN
Project Mgr: N.R.	Revision:
Proj No: 49301J05	File No: 49301097

Figure

9



LEGEND

- ZONE BOUNDARY – DASHED WHERE APPROXIMATE
- SEDIMENT SAMPLING LOCATION (REFERENCE AREA)
- + SEDIMENT AND SURFACE WATER SAMPLING LOCATION (REFERENCE AREA)
- + SEDIMENT AND SURFACE WATER SAMPLING LOCATION
- SEDIMENT SAMPLING LOCATION (RISK ASSESSMENT)
- ▲ MONITORING WELL, SEDIMENT AND SURFACE WATER SAMPLING LOCATION
- ◆ SEDIMENT SAMPLING LOCATION (REMEDIAL ASSESSMENT)

SOURCE

1.) PHOTOGRAPH TAKEN DECEMBER 29, 1994 WHEN ON-SITE INCINERATOR WAS ACTIVE.

600' 0' 600'

Title:

WETLANDS SAMPLING LOCATIONS

BRIDGEPORT RENTAL & OIL SERVICES SITE
LOGAN TOWNSHIP, NEW JERSEY

Prepared For:

BROS TECHNICAL COMMITTEE

ROUX

ROUX ASSOCIATES INC
Environmental Consulting
& Management

Compiled by: N.R.

Prepared by: J.S.G.

Project Mgr: N.R.

Proj No: 49301J05

Date: 07/01/98

Scale: SHOWN

Revision:

File No: 49301099

Figure

10



C

301231

APPENDIX C
RESUMES OF KEY PROJECT PERSONNEL

Peter P. Brussock, Ph.D.
Vice President of Environmental Planning
Environmental Liability Management, Inc.

PROFESSIONAL EXPERIENCE

ENVIRONMENTAL LIABILITY MANAGEMENT, INC.

Princeton, NJ, March 1990 to Present

VICE PRESIDENT OF ENVIRONMENTAL PLANNING

Responsibilities include oversight of the environmental planning services, environmental assessment and management of contaminated sites, preparing redevelopment and land reuse plans, site-specific and regional planning evaluations, preparing public health and ecological assessments, developing risk-based corrective action plans, preparing cleanup cost allocation evaluations, as well as providing expert services to clients, especially on surface water and ground water cases; CERCLA, RCRA, NPDES Permit, New Jersey ISRA and Spill Act; Pennsylvania Land Recycling Program (Act 2) and HSCA, Clean Streams Law, and Solid Waste Act. Dr. Brussock is also responsible for technical and regulatory training of the ELM staff.

ENVIROLOGIC DATA, INC. (SUBSIDIARY OF GROUNDWATER TECHNOLOGY, INC.)

Chadds Ford, Pennsylvania, February 1989 to March 1990

PRINCIPAL SCIENTIST - responsibilities included directing all aspects of human health and ecological risk assessment services in the Mid-Atlantic states for CERCLA, RCRA and ISRA facilities.

NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION

Trenton, NJ, February 1986 to March 1989

SECTION CHIEF (ISRA, Formerly ECRA; CERCLA; New Jersey Spill Act) - responsible for supervision and management of up to six case managers and two supervisors in a section assigned over 200 high environmental concern industrial facilities (all sites with significant soils, surface water, and ground water contamination). Management focus on risk-based remediation reuse and redevelopment of industrial sites.

TECHNICAL COORDINATOR - responsible for technical aspects of hazardous site investigations and feasibility studies, primarily soil and water contamination problems; CERCLA, ISRA and RCRA sites. Utilized site-specific risk assessment in the context of current and future land use to develop cleanup strategies.

EDUCATION

Ph.D., University of Arkansas, Fayetteville, Arkansas
Aquatic Ecology and Water Resources, 1985

B.A., Lehigh University, Bethlehem, Pennsylvania
Biology, 1981

Drexel University, Philadelphia, Pennsylvania
Post-Graduate Coursework, 1987, 1989, 1991

Bucks County Community College, Newtown, Pennsylvania
Post-Graduate Coursework, 1989, 1990

Delaware Valley College, Doylestown, Pennsylvania
Post-Graduate Coursework, 1993, 1997

CERTIFICATIONS AND REGISTRATIONS

Certified Senior Ecologist, No. 313, Ecological Society of America

Certified Ground Water Professional, Association of Ground Water Scientists and Engineers, National Ground Water Association, CGWP #359

Certified Hazardous Materials Manager (CHMM), Institute of Hazardous Materials Management, Senior Level, No. 1795

Licensed For Tank Closure/Subsurface Investigations, New Jersey Department of Environmental Protection, UST License No. 0009939

Professional Geologist, Board of Registration for Professional Geologists, Commonwealth of Kentucky, License Number 513

Professional Wetland Scientist, Society of Wetland Scientists, Number 108

PROFESSIONAL APPOINTMENT AND REGULATORY COMMITTEES

**Risk Assessment Subcommittee To The Cleanup Standards Scientific Advisory Board
(Pennsylvania's Land Recycling Program)**

Established by Pennsylvania Act 2, Subcommittee Member contributing to development of Medium Specific Standards, Ecological Standards, Site-Specific Standards and Regulations related to each.

Planning Commission Member

Solebury Township, Pennsylvania. Four year appointment. Responsible for review, evaluation, and recommendations on development and subdivision plans, especially those including environmental impact assessments.

Environment Advisory Task Force

Established by the New Jersey Industrial Site Recovery Act (ISRA), the Task Force will make recommendations to the NJDEP on the feasibility, development, and application of remediation standards protective of ecological receptors and the environment.

SELECT TEACHING EXPERIENCE

Adjunct Faculty

Delaware Valley College, Doylestown, Pennsylvania, 1994-1998

- Responsible for teaching Applied Toxicology and Risk Assessment course.

Professional Training Courses

Risk Assessment Under The Land Recycling Regulations and Act 2, 1995, 1996, 1997

- Directed training of Pennsylvania Department of Environmental Protection employees on Human Health and Ecological Risk Assessment/Risk Management.

PROFESSIONAL MEMBERSHIPS AND AFFILIATIONS

American Chemical Society

American Institute of Certified Planners

American Planning Association

- Division of Environment, Natural Resources and Energy

American Society for Testing & Materials (ASTM)

American Water Resources Association

Ecological Society of America

National Ground Water Association, Association of Ground Water Scientists & Engineers

North American Benthological Society

Sigma Xi, The Scientific Research Society

Society for Ecological Restoration

Society of Environmental Toxicology and Chemistry

Society for Risk Analysis

Society of Wetland Scientists

Water Environment Federation

COMPLETE CURRICULUM VITAE AVAILABLE UPON REQUEST

Neil R. Rivers

Principal Engineer

Technical Specialties:

Remedial investigations and feasibility studies at hazardous waste sites. Hazardous waste treatment and disposal technologies. Bioremediation and thermal desorption technologies. Industrial and environmental process engineering. Regulatory agency negotiations and compliance strategies.

Experience Summary:

15 years of experience: Principal Engineer for Roux Associates, Vice President at Environmental Compliance Services, Project Engineer at Roy F. Weston, and Technical Supervisor of Environmental Affairs and Process Engineering at NVF Company.

Credentials:

B.S. Biology, Widener University, 1980.

28 M.S. Credits in Env. Engineering, Univ. of Delaware (in progress).

Licensed Industrial Wastewater Treatment System Operator (N-2).

Key Projects:

- Engineer managing \$1.4 million RI/FS at Southern Maryland Wood Treating NPL Site in Hollywood, Maryland. Designed and prepared RI/FS Work Plan, managed RI Field activities, authored RI Report and FS Report. The site was contaminated by PNAs, PCPs and dioxins from disposal of waste waters and sludges in several unlined lagoons. Impacted media included soils, ground water, surface water and stream sediments. Non-aqueous phase liquids were encountered in the water table aquifer. Remedial alternatives proposed for the site included incineration, sheet piling, capping, ground-water extraction, sediment removal and sediment containment.
- Engineer managing \$1.6 million RI/FS at Fried Industries NPL Site in East Brunswick, New Jersey. Prepared the RI/FS Work Plan, Project Operations Plan, Quality Assurance Project Plan and Health and Safety Plan. The RI entailed characterization of volatile organic compounds and acids in soils and ground water resulting from drum disposal activities.
- Principal-in-Charge responsible for the FS and Remedial Design at an aerospace equipment manufacturing facility in central New Jersey. Volatile organic compounds and heavy metals have been detected in two water-bearing zones underlying the site. In addition, the site is located adjacent to an extensive wetland system designated by NJDEP as a Natural Area requiring special protection. Remedial measures include soil excavation and capping, ground-water extraction and sediment removal. Through the use of ecological risk assessment methods, natural remediation was approved for most of the wetlands areas.
- Principal-in-Charge responsible for a \$4 million RI/FS. Remedial Design and Remedial Action at a petroleum distribution terminal in northern New Jersey. Ground water was impacted by dissolved and separate-phase petroleum compounds. The remedial program included the treatment of 18,000 cubic yards of impacted soils and sediments by thermal desorption; ground-water remediation and separate-phase product recovery; asbestos removal and the implementation of a stormwater management system.
- Principal-in-Charge of a remedial investigation for a landfill site in Logan Township, New Jersey. A disposal area, located adjacent to Maple Swamp, contains chromium sludges and other heavy metal compounds. Project activities have included landfill delineation and characterization, evaluation of ground-water quality, assessment of local and regional geology/hydrogeology and preliminary screening of remedial options.
- Principal-in-Charge for a remedial investigation and compliance program for a 1,200 acre explosives manufacturing plant in New Jersey. Site activities have included identification, evaluation and prioritization of potential Areas of Concern, development of a facility-wide Discharge Prevention, Containment and Countermeasure Plan, and preparation of a Landfill Closure Plan.

- Engineer leading technical peer review of FS Report for Shore Realty NPL Site in Glenwood Landing, New York. Volatile organic compounds were detected in soils, ground water and sediments. Risk assessment methodologies and the demonstrated effectiveness of soil vapor extraction (SVE) at the site were used to support a remedial strategy that employed SVE as opposed to incineration (NYSDEC's preferred alternative) for source removal.
- Engineer responsible for technical review of key project deliverables as part of the \$40 million U.S. EPA REM II Contract. Responsible for review for strategic direction, technical accuracy, and administrative completeness. Completed technical review for the following projects/sites:
 - Bruin Lagoon; Butler, PA - RI Work Plan, Project Operations Plan, RI Report
 - Ordinance Works Disposal Site; Morgantown, WV - RI Work Plan, Project Operations Plan, RI Report
 - Drake Chemical; Lock Haven, PA - Remedial Design
 - Roebbling Steel; Florence, NJ - RI Work Plan, Project Operations Plan, Health and Safety Plan
 - Henderson Road; Upper Merion, PA - Focused Feasibility Study
 - Ambler Asbestos Piles; Ambler, PA - RI Work Plan, Project Operations Plan, RI Report
 - L.A. Clarke; Spotsylvania, VA - RI Work Plan, Project Operations Plan, RI Report
 - Myers Property; Franklin Township, NJ - RI Work Plan, Project Operations Plan, RI Report
 - Tabernacle Drum Dump; Tabernacle, NJ - RI Work Plan, Project Operations Plan
 - Palmetto Wood Preserving; Dixiana, SC - Feasibility Study
- Engineer responsible for development of technical approach to RI/FS for the Bayou Bonfoca NPL site in Slidell, Louisiana. Developed and screened preliminary remedial alternatives and prepared a focused RI Work Plan to gather data for FS and remedial design. Soils and sediments within wetlands at the site have been impacted by PNAs from waste disposal lagoons.
- Principal-in-Charge of RCRA Corrective Action project at an 11 acre metals finishing facility in Florence, South Carolina. Soils, ground water, surface water and sediments are impacted by chlorinated VOCs and metals. The RCRA Facility Investigation has identified ground-water contamination in two aquifers. Interim Corrective Measures have been implemented and include landfill closure, lagoon closure and ground-water extraction. Project activities include strategic planning and management, regulatory agency negotiations, and technical review of project deliverables.
- Project Manager responsible for development and implementation of training program for consultant/contractor personnel assigned to REM II projects. Program moderator and primary instructor responsible for teaching personnel the technical and administrative procedures for conducting CERCLA projects under REM II. Instructed USEPA and contractor personnel assigned to development of CERCLIS database in remedial and removal projects.
- Lead Engineer for evaluation of process engineering, waste generation and disposal practices in support of CERCLA litigation project. Technical activities included the identification of process waste streams and fugitive waste streams; evaluation of waste characteristics; assessment of historical waste water treatment and sludge treatment and disposal methods; and evaluation of CERCLA RI/FS scope, methods and results.
- Principal-in-Charge of oversight and auditing of hazardous waste site remedial activities. Prepared reports for the contractor's pollution liability insurance carrier based upon field audits and report evaluations.
- Lead Project Engineer responsible for the identification, evaluation, and ranking of SWMUs at all stateside U.S. Army facilities. Designed program for evaluation and ranking based upon HRS model. Developed verification program to validate model.

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Paul D. Rosenstock, Ph.D., CIH

Principal Chemist

Technical Specialties:

Process safety, permitting, pollution prevention and waste minimization, environmental and safety auditing, emergency response, planning and litigation support training, ISO 9000 and ISO 14001 standards, chemical and polymer manufacturing and plastics processing technology.

Experience Summary:

35 years experience: 27 years at Rohm and Haas in various technical, regulatory and management assignments in support of chemicals and plastics manufacturing and in line management of utility and wastewater treatment operations. 15 years were spent in environmental and safety assignments, including leadership roles in a number of trade and technical organizations. 2 years at BCM Engineers, Plymouth Meeting as Vice President in charge of air program for eastern region and 2.5 years at Suvar Corporation as Director of Environmental, Health and Safety. Two years classified research (army service) work at Edgewood Arsenal and 2 years as Senior Research Medicinal Chemist at National Drug Company.

Credentials:

Ph.D. in Chemistry, Pennsylvania State University, 1960.
B.S. in Chemistry, Polytechnic Institute of Brooklyn, 1956.
Certificate, Wharton Management Program, University of Pennsylvania, 1972
Numerous publications in journals and books.
Certified Industrial Hygienist in General Practice

Professional Affiliations:

American Industrial Hygiene Association
Water Resources Association of the Delaware Basin (Past Chairman)

Key Project Experience:
Compliance Support Services

- Prepared OSHA Process Safety Management Manual, did HAZOP review of processes, set up training, maintenance and inspection schedules, and wrote necessary standard operating instructions for a 12 million pound per year resins manufacturing plant.
- Developed and managed a 5year regulatory compliance plan (DOT, EPA, OSHA and New Jersey regulations) for a resin manufacturing plant that balanced regulatory requirements against available resources. Plant passed DPCC, RCRA and indepth OSHA Chemical Process Safety Management inspections. Major elements of the plan were:
 - A base line exposure assessment, developed Hazard Assessment and implemented personal protective equipment program for a resin manufacturing plant. PPE program prevented disfiguring injury and potential worker death in a major accident.

- Preparation of an Air Emissions Impact Statement, a permit review and development of a strategy for meeting regulatory requirements, including installation of a catalytic thermal oxidizer on process kettle vents.
- Writing Discharge Prevention, Containment and Countermeasures (DPCC) and Discharge Cleanup and Removal Plans (DCR) and managing the implementation of modifications needed for the compliance schedule.
- Preparation of a Contingency and Response Plan to comply to OSHA and RCRA regulation, training personnel on plan and conducting successful drills with local response agencies.
- Managed study to determine the potential impacts of the Clean Air Act Amendments on 26 manufacturing sites for a Fortune 500 company. Data were supplied by individual plants, entered into a database and evaluated in terms of major source criteria under the Clean Air Act Amendments of 1990. Plants were contacted by telephone to verify data and conclusions were based on federal and state regulations. Strategic planning was done on the basis of these results for those plants that would require Title V permitting and/or installation of new air abatement equipment.
- Prepared Pollution Prevention Plan for a solution polymers manufacturing facility as required under New Jersey regulations. The plan including economic analysis, technology review and establishment of an action plan for waste minimization of waste streams containing SARA313 listed chemicals. Reduced waste disposal costs by 22 percent in 1994 through plan implementation.
- Wrote Stormwater Pollution Prevention Plans for two polymer manufacturing sites and managed plan implementation. Action plans required significant modification to storage tank diking, tank truck loading/unloading areas, outdoor drum storage areas and diversion of stormwater runoff from active manufacturing areas.
- Prepared RCRA Part B storage permit in Pennsylvania DEP Region I and EPA Region III for a large chemicals manufacturing facility. The permit was approved with generic categories of wastes and use of drum banding to indicate compatibility classes. Implementation also required construction of a roofed storage area with 11 cells and a capacity for 1026 drums and one tank truck trailer.

William B. Gilchrist, P.G.

Senior Hydrogeologist

Technical Specialties:

Design and implementation of soil and ground-water investigations. Management of Property Transfer/Merger/Acquisition projects. Development of ISRA compliance strategies. Preliminary design and supervision of remediation projects. Regulatory coordination and negotiations. Interpretation of Federal and State regulations. Development and implementation of multisite Phase I and II environmental assessments.

Experience Summary:

Twelve years of experience: Senior Hydrogeologist with Roux Associates, Inc.; Supervising Geoscientist with McLaren/Hart Environmental Engineering Corp.; Senior Project Geologist with EEC Environmental Inc. (now Harding Lawson Associates); Senior Geologist with New Jersey Department of Environmental Protection Bureau of Groundwater Pollution Abatement; Geologist with Texas Oil and Gas Corporation.

Conducted state-lead investigative and remedial activities under NJDEP, PADEP, NYSDEC, CDEP, and IEPA among others. Conducted USEPA-lead investigations under the jurisdiction of RCRA, CERCLA, CWA and TSCA.

Credentials:

B.A. Geology, Ohio Wesleyan University, 1983
M.S. Geology, Eastern Kentucky University, 1986
Professional Geologist in Pennsylvania, Delaware, Kentucky and Tennessee
NJDEP UST Certification for Subsurface Evaluation; 40 hour and Supervisors OSHA Health and Safety Training

Key Projects:

- Project Manager of an ISRA triggered Site Investigation/Remedial Investigation/Remedial Action at a 20-acre former electrical generating plant/battery manufacturing facility/microprocessor manufacturing facility which had 17 areas of concern (AOCs). Significant soil excavation was performed to remove soils contaminated with metals, volatiles, polynuclear aromatic hydrocarbons (PAHs), and total petroleum hydrocarbons. Where residual concentrations of contaminants were detected, the NJDEP accepted a Declaration of Environmental Restriction (DER). Ground-water contamination, primarily volatile organic compounds (VOCs) were detected in the bedrock and overburden aquifers. After a significant ground-water investigation, including use of a Geoprobe and mobile laboratory, the ground-water plume was delineated and an air sparging/soil vapor extraction AS/SVE system was designed. The installation of the AS/SVE system was proposed to eliminate the VOCs from discharging to a small creek which passed through the site. A Classification Exception Area (CEA) was proposed for low concentrations of VOCs in the bedrock aquifer. Ground-water issues were currently being implemented.
- Managed the completion of two multi-site property transfer environmental assessments at numerous industrial facilities in approximately twenty states. Activities included scheduling personnel from numerous offices having different disciplines (geologist, hydrogeologist, engineer, scientist, etc.), project direction, data review, report preparation, and negotiation assistance between purchaser and owner. In both cases a significant escrow account was negotiated to handle the many environmental issues identified during the assessments.

- Managed the field activities associated with the implementation of a Remedial Investigation (RI) of a CERCLA site in southern New Jersey. The RI included the completion of an extensive soil, ground water and soil gas sampling effort using a Geoprobe and the installation and sampling of numerous monitoring wells to delineate the source area and ground-water plume.
- Project Manager for a RCRA ground-water investigation in southeastern Pennsylvania. Ground water was impacted by chlorinated solvents in both the overburden and fractured bedrock aquifers. A Consent Order was negotiated with USEPA Region III and an Interim Measures Work Plan (IMWP) and RCRA Facility Investigation Work Plan (RFIWP) were submitted and approved. A ground-water extraction system was proposed for the overburden aquifer in the IMWP. A bedrock monitoring well network was installed which included coring and packer testing to assist with determining the hydrogeology of the site. The IM has been constructed and the bedrock investigation is continuing.
- Served as client contact for Fortune 50 conglomerate. Managed environmental investigations at manufacturing facilities in Pennsylvania, Ohio, New York, Illinois, Michigan, Texas, California and Baja California, Mexico. Environmental investigations typically included a Phase I environmental assessment and soil and ground-water investigations. Environmental investigations were completed as a corporate policy to determine environmental problems and liabilities at their sites and remediate the problems, if necessary, with the goal to get the state regulatory agencies to issue a "No Further Action Necessary" letter. Remedial activities were performed at several sites. Negotiated project scope and remedial activities with several state regulatory agencies. Worked closely with facility managers, corporate environmental managers and their counsel.
- Project Manager for a NJDEP Bureau of State Case Management site investigation and remediation performed in accordance with an ACO. The metal alloy and fabrication facility included a chlorinated solvent ground-water plume and numerous areas of concern including: a landfill, settling ponds and septic system which received industrial waste. The landfill was investigated and found to contain waste ceramic sands which had low levels of radiation. An investigation performed by a radiation physicist determined that normal contact with the landfill posed no adverse health risks. The septic system was excavated and sludges with high concentrations of metals were disposed as hazardous waste. The NJDEP approved no further excavation of soils in the vicinity of the settling ponds and septic systems with ground-water monitoring. Metals were found at a number of NJDES DSW outfalls on the site. It was anticipated that the NJDEP would accept limited hot spot removal with continued ground-water monitoring and a DER to allow leaving most of the metal contaminated sediment in place on the site.
- Performed and/or managed approximately 150 Phase I environmental assessments completed as part of property transfer due diligence process. Phase I's were performed in New Jersey, Pennsylvania, Connecticut, New York, Illinois, Wisconsin, Texas, Oklahoma, Louisiana, and California. The Phase I's were completed in accordance with ASTM standards.

John A. Lucey, P.G.

Project Geologist

Technical Specialties:

Environmental site assessments, geophysical surveys, and the investigation and remediation of ground-water and soil contamination.

Experience Summary:

10 years experience: Project Geologist at Roux Associates, Inc.; Project Geologist at Walter B. Satterthwaite Associates, Inc.; Senior Hydrogeologist at Clean Technologies, Inc.; Geologist at Roux Associates, Inc. Conducted environmental site assessments at industrial facilities, participated in ground-water and soil investigations, participated in the design and installation of remedial systems, managed subcontractors and field activities.

Credentials:

M.S. Geology, University of Delaware 1994.

B.S. Geology, University of Delaware 1985.

Professional Geologist No. PG-003138-G. Commonwealth of Pennsylvania

New Jersey-Certified Subsurface Evaluator and Closure No. 3468

OSHA 40-hour Health and Safety.

Certified Mobile Environmental Mass Spectrometer Operator

Key Projects:

- Evaluated hydrogeologic data and downgradient sentinel well locations and supervised the installation of the sentinel wells in the PRM aquifer system at the Harvey and Knotts Superfund site. Audited ground-water sampling and sample handling procedures on behalf of a PRP. Prepared the surface soil sampling plan for the Harvey and Knotts Superfund site. The sampling plan included field screening with using x-ray fluorescence and the collection of confirmatory soil samples for laboratory analysis. Contaminants of concern included heavy metals.
- Geologist responsible for evaluation of ground-water analytical results and hydrogeologic data from the Tybouts Corner Superfund site on behalf of a Potential Responsible Party (PRP). The ground-water analytical data review included data evaluation, construction of isoconcentration maps, an evaluation of potential gradients between the Columbia Formation and the PRM aquifer system; an evaluation of monitoring well construction details, and the production of ground-water flow maps. Contaminants of concern included chlorinated volatile organic compounds.
- Assisted in the preparation of a Remedial Investigation Work Plan (RIWP) and conducted hydrogeologic investigations for a former chromium pigments manufacturing facility in Pennsylvania. The RIWP included soil sampling to evaluate production areas, raw materials storage, petroleum storage, and on-site disposal areas. Hydrogeologic investigations included the analysis of slug test, pump test and ground-water elevation data to evaluate the horizontal and vertical distribution of constituents in a fractured aquifer.
- Directed multi-phase remedial investigation at a 150-acre chemical manufacturing facility in southern New Jersey. Soils investigations included the installation and sampling of over 300 soil borings, geophysical surveys, and test pitting. Ground-water investigations included the installation and sampling of monitoring wells and the sampling of industrial supply wells installed in the Potomac-Raritan-Magothy (PRM) aquifer system. Surface-water drainage investigations included surface water and sediment sampling in on-site drainage systems, retention basins and the Delaware River. Additional investigations included waste water lagoon sludge and gas sampling for remedial options analysis. Contaminants of concern at the site include polychlorinated biphenyls, petroleum fuels, volatile organic compounds and asbestos-containing material.
- Coordinated remedial investigations at a 160-acre pharmaceutical manufacturing facility in northern New Jersey. Ground-water investigations included monitoring well installation, monitoring well sampling, slug testing, step drawdown tests, and field screening using the HydroPunch™ sampling techniques. Soil investigations included soil boring sampling, soil gas survey, and test pitting. Contaminants of concern include chlorinated volatile organic compounds and petroleum fuel constituents.
- Prepared a Regional Water Supply Study for an industrial facility in New Jersey that included an assessment of the regional ground-water and surface-water quality, the identification of ground-water and surface-water withdrawal points, the identification of potential sources of ground-water and surface-water contamination, an evaluation of public water supply sources within the region and the modeling of well head protection areas around public supply wells.
- Participated in ground-water and soils investigations at a former chromium ore processing facility in Pennsylvania. Ground-water investigations included the installation and sampling of well points and the evaluation of ground-water elevation data. Soils investigations included the installation and sampling of soil borings to evaluate site conditions and support closure of a wastewater lagoon.
- Coordinated remedial investigations and remedial activities at a specialty paper manufacturing facility in central New Jersey as part of property transfer transactions. Remedial investigations and remedial activities were conducted at an accelerated pace to fulfill the requirements of the agreement of sale. Contaminants of concern included metals, PCBs, petroleum fuels and polynuclear aromatic hydrocarbons.
- Coordinated ground-water and soil investigations at industrial facilities, landfills, gasoline service stations and bulk petroleum storage facilities. Responsibilities included the selection of subcontractors and laboratories, supervising field activities, compiling work plans and sampling plans, data analysis and review, notification of regulatory agencies and the preparation of summary reports.

Brigid M. Tigani Staff Geologist

Technical Specialties:

Investigation and remediation of ground-water and soil contamination.

Experience Summary:

3 years experience as Staff Geologist with Roux Associates, Inc. Assisted in ground-water and soil investigations, oversight of subcontractors and field activities.

Credentials:

B.S. in Geology, University of Delaware, 1995
OSHA 40-Hour Health and Safety Training

Key Projects:

- Field coordinator for remedial investigation activities at a former paint and coal tar manufacturing facility in central New Jersey. Areas of concern include abandoned USTs, buried drum and container areas, and isolated subsurface seams of coal tar. Primary constituents of concern include PAHs, VOCs, and metals. Responsibilities included subcontractor oversight, monitoring well installation, soil boring installation and geological logging, soil sampling, and data management.
- Field coordinator for site/remedial investigations for soil and ground-water conducted at a former insulation manufacturing facility in Southern New Jersey. Areas of concern include abandoned USTs, waste water treatment settling lagoons, heat transfer fluid storage and transfer areas, transformer pads, and buried asbestos disposal areas. Primary constituents of concern include PAHs, bi-phenyl and phenyl ether, VOCs, asbestos, PCSs, and metals. Responsibilities included soil borings utilizing hollow-stem auger and Geoprobe®, hot-spot removal, monitoring well installation utilizing a hollow-stem auger drilling, and ground-water sampling.
- Assistant in preparation of the Annual Report of RCRA Corrective Action project at an 11-acre metals finishing facility in Florence, South Carolina. Activities include analysis of ground-water elevations and VOC-contaminant trends, data management, and state reporting.
- Field team member for remedial investigation activities at a former pigments manufacturing facility in northeastern Pennsylvania. Activities included the installation and geological logging of over 100 soil borings using Geoprobe® techniques, soil sampling, and ground-water sampling utilizing low-flow purging techniques. Contaminants of concern include chromium and petroleum fuels.
- Participated in ground-water investigation activities for an electronics manufacturing facility in central New Jersey. Activities included assisting oversight during installation of monitoring wells utilizing hollow-stem auger techniques, ground-water sampling, aquifer testing, and data management. Contaminants of concern include VOCs and acetone.
- Project coordinator for ground-water investigations a former chemical manufacturing facility in central New Jersey. Responsibilities include development and implementation of ground-water sampling of over thirty monitoring wells, data management, and report preparation.
- Participated in a multi-phase remedial investigation at a 150-acre chemical manufacturing plant in New Jersey. Activities included the installation of monitoring wells, the installation and geological logging of soil borings, soil and lagoon sludge sampling, ground water sampling, and aquifer testing.
- Field team member for ISRA-related field activities at a former fiberglass manufacturing facility in southern New Jersey. Activities included soil boring installation utilizing Geoprobe® techniques, soil sampling, ground-water sampling, and aquifer testing.
- Assisted in site-wide screening of a 1,200-acre former explosives manufacturing facility in northern New Jersey. Activities included soil, sediment, and sludge sampling to determine contamination distribution.
- Oversight during the abandonment of monitoring wells utilizing hollow-stem auger and air rotary techniques at a former agrichemical research facility in northern Delaware.
- Utilized Hydropunch® techniques to determine extent of ground-water contamination at multiple sites throughout New Jersey.
- Conducted monitoring well gauging, purging and sampling in accordance with NJDEP's Field Sampling Procedures Manual.
- Performed geological and geophysical logging of boreholes in the coastal plains of New Jersey.
- Assisted in preparation of sampling plans for hazardous waste site in accordance with the New Jersey Technical Requirements for Site Remediation.

Joanne Yeary

Senior Hydrogeologist/Quality Assurance Officer

Technical Specialties:

Quality assurance reviews/technical editing and aquifer test analysis.

Experience Summary:

12 years of experience: Senior Hydrogeologist and Geologist with Roux Associates. Supervised several ground-water, soil and surface-water sampling programs. Assisted in ground-water modeling projects and performed aquifer test analyses. Prepared numerous hydrogeologic reports.

Credentials:

B.S. Geology, S.U.N.Y. Stony Brook, 1986.

Professional Affiliations:

National Ground Water Association

Key Projects

- Quality Assurance Officer for numerous site investigations involving soil and ground-water contamination. Responsible for assuring that statements and conclusions in final reports are supported by analytical data.
- Performed quality assurance review of a final report for a CERCLA hazardous waste site in Massachusetts (#5 on the NPL). Responsible for assuring that results of subcontractor investigations, and statements and conclusions drawn in the final report, are supportive of the analytical data.
- Quality Assurance Officer for several remedial investigation projects in Pennsylvania and North Carolina. Edited and assured accuracy of geologic logs, maps, tables, calculations, and final report text. Checked for consistency between final reports and all supporting data.
- Quality Assurance Officer on an expert report performed in support of litigation for a former industrial facility located in New Jersey.
- Performed quality assurance review on two remedial investigation workplans, including a review of subcontractor reports.
- Performed quality assurance review on both the Feasibility Study and the Focused Feasibility Study for a site with soil and ground-water contamination on Long Island, New York.
- Quality Assurance Officer for several pesticide projects. Assured that data, reports and archives adhere to EPA Good Laboratory Practice standards.
- Designed computer database for analytical data being generated at a large site in Rhode Island.
- Supervised Remedial Investigation at a CERCLA hazardous waste site on Long Island, New York.
- Supervised well installations, ground-water sampling, soil sampling and surface-water sampling at a CERCLA hazardous waste site in Massachusetts which is ranked #5 on the NPL.
- Participated in pesticide monitoring studies in ground water, soils, rivers, and streams. Projects included retrospective studies, prospective studies, and detection follow-ups. Evaluated findings of state monitoring programs. Edited sampling reports following EPA Good Laboratory Practice standards.
- Performed multiple aquifer tests at a site in Queens, New York. Analyzed slug test, constant-rate pumping test, and recovery test data to determine hydraulic coefficients of the Upper Glacial aquifer, and prepared summary report.
- Analyzed data from multiple aquifer tests (constant rate pumping tests, step tests, slug tests, recovery tests) and prepared reports summarizing hydraulic coefficients for a site in Rhode Island.
- Performed and analyzed data from multiple slug tests as part of a Remedial Investigation at a site in Nassau County, Long Island. Prepared report summarizing hydraulic coefficients.
- Participated in slug tests at a hazardous waste site in Suffolk County, Long Island as part of a Phase II investigation at a property on the NYSDEC list of inactive hazardous waste sites.
- Analyzed slug test data for three NYSDEC Phase II Investigations in Suffolk and Nassau Counties, Long Island, and prepared summary report for each.
- Wrote hydrogeologic report in support of a water allocation permit to remediate groundwater at an industrial site in New Jersey.
- Co-wrote ground-water contingency plan for a major bulk petroleum storage facility in Long Island, New York.
- Prepared Phase II Remedial Investigation final report for a railroad facility in Queens, New York. Report summarized results of a 5-year investigation of soil and ground-water quality.
- Developed, wrote and managed field sampling plan as part of a Remedial Design for a site in New York requiring soil and sediment remediation.
- Prepared report summarizing current soil conditions at an industrial site in New Jersey.
- Prepared report summarizing results of a soil and ground-water investigation performed in New York for a public water supply company.
- Wrote Phase II report in accordance with the Massachusetts Contingency Plan for a former service station in Massachusetts.

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Aquifer Drilling & Testing, Inc.***H.L. Rexrode, Jr.***
Resume

Len Rexrode will serve as drilling manager for this project. Mr. Rexrode has 20 years of drilling experience working within the fields of geology and hydrogeology. In 1989, he founded Aquifer Drilling and Testing, Inc. (ADT), of which he is currently President and Owner.

Mr. Rexrode holds a B.S. Degree in Geology from James Madison University, 1979, and attended Stephen F. Austin University, studying petroleum geology in 1983-1984. From 1979 until 1986, he worked as a field geologist. From 1986 to 1989, he worked as a hydrogeologist on numerous Phase I and Phase II projects involving drilling.

Since 1989, he has supervised hundreds of environmental and geotechnical drilling projects in the Midatlantic and Northeast regions of the United States. These projects include State and Federal Superfund jobs.

Mr. Rexrode is also Vice President of the Northeast Section of the American Institute of Professional Geologists, a Certified Professional Geologist - AIPG, and has a New Jersey Well Drillers License.

Lonnie Fallin

Mobile Lab Chemist

Mr. Fallin has over ten years of hands-on environmental laboratory experience as a chemist and laboratory manager. Mr. Fallin is a mobile lab manager for ONSITE, providing analysis at mobile lab and close support lab projects.

Prior to ONSITE, Mr. Fallin was a senior chemist for Groundwater Analytical where he analyzed soil and water samples for volatiles and semi-volatiles by GC and GC/MS, and managed the technical operations for EPA 500 series, 600 series, and 8000 series. Mr. Fallin reviewed data for VOCs, SVOCs, PCB/Pesticides, herbicides, and petroleum hydrocarbons.

At Phoenix Analytical Laboratories, Inc. in Broomfield, CO Mr. Fallin was a Laboratory Manager and Technical Advisor for three years. Mr. Fallin managed the technical operations and technical personnel, reviewed VOC and SVOC GC and GC/MS data and generated final reports. Mr. Fallin also was active in performing instrument maintenance and repair.

Prior to his lab manger position, Mr. Fallin managed the LIMS department for the laboratory, which involved maintaining and supporting a Novell network and operating optical storage drives.

Mr. Fallin was a chemist for Phoenix Analytical Laboratories for five years where he had hands-on experience performing VOC and SVOC analysis by GC/MS. Mr. Fallin also performed SVOC sample preparation and extractions. Mr. Fallin generated reports, performed QA/QC review, and trained other chemists in the operation of GC/MS systems.

Mr. Fallin is knowledgeable on a variety of software packages which includes HP Chemstation/EnviroQuant Software, PE Turbochrom, Excel, Word, and DOS.

Mr. Fallin has consulted to clients as an expert witness in preparation of data for court presentation.

Mr. Fallin holds a B.A. in Chemistry from the University of Colorado at Boulder, CO.

Rachel L. Kreamer, B.S.
Group Leader
Environmental Client Services

Current Responsibilities:

Group Leader, Environmental Client Services (1996-Present)

- Supervises a staff of 13 client service representatives and support personnel.
- Coordinates client requirements with technical groups and ensures they are met.
- Acts as a technical contact for clients on all of our analytical capabilities.
- Reviews reports before they are sent to clients.
- Audits client paperwork for incoming environmental samples.

Previous Experience:

Clerical Lab Technician, Lancaster Laboratories (1987-1988), Lab Technician (1988-1989), Technical Services Administrator (1989-1990), Technical Services Specialist (1990-1993), Client Services Specialist (1993-1995), Client Services Specialist/Coordinator (1995-1996)

Education:

B.S., Biology, Eastern Mennonite College (1980)

DAVID J. BROKAW
PROGRAM MANAGER

EDUCATION B.S., Eastern Michigan University
Major: Chemistry, 1988
Major: Ecosystems Biology, 1985

EXPERIENCE **SAFETY-KLEEN (ENCOTEC), Inc. (December 1989-present)**
Ann Arbor, MI

PROGRAM MANAGER (July 1997-Present)

Responsible for management of clients projects. Principle accountabilities include customer service as well as submittal of quotations, data, and invoicing. Daily responsibilities include sample tracking, data compilation, as well as compliance to approved testing methodologies and data review. Involved with on- site and off-site client visits and technical support.

WASTE PROGRAM MANAGER (October 1995-June 1997)

Provide supervision and management of the Waste Profile Group as well as the Dioxin Laboratory. Provide customer support in regard to analytical results and requirements. Conduct day to day supervision of laboratory personnel and activities including purchasing, building maintenance, training, data review, and scheduling of analyses. Also involved in management activities such as business planning and interviewing.

PROJECT MANAGER (March 1995-October 1995)

Responsible for customer support and management of inter-company subsidiaries and private client environmental analytical testing. Principle accountabilities include submittal of quotations, client contact, sample tracking, data compilation and review, and report generation. Familiarity and knowledge of NPDES, land disposal restrictions, RCRA and other EPA/MDNR hazardous waste disposal regulations.

GROUP LEADER-CLP ORGANICS (April 1992-March 1995)

Provide supervision and management of the CLP-Organic Group. Responsible for the oversight of sample analyses, data summary, and sample throughput according to E.P.A. CLP methodologies. Responsible for the implementation of new procedures and/or methods in response to client request, sample matrix, safety considerations, or technological advancements. Conducts day to day supervision of laboratory activities including purchasing, maintenance, training and scheduling of analyses. Also involved in management activities such as business planning and interviewing.

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ASSISTANT GROUP LEADER-GC/HPLC (Jan. 1992-April 1992)

Responsible for the supervision and training of analysts involved with volatiles, pesticides, herbicides, and miscellaneous analyses. Performed secondary and final review of all lab data. Responsible for maintenance and trouble shooting of Varian 3700, 3600, 3400, VISTA, and Tracor GC's including autosamplers. Other responsibilities included sample database updates and project summary reports.

SENIOR CHEMIST (Dec. 1989-Jan. 1992)

Responsible for the supervision and training of analysts involved with pesticides, herbicides, and miscellaneous analyses. Performed secondary and final review of lab data. Responsible for maintenance and trouble shooting of Varian 3700, 3600, 3400, and VISTA GC's including autosamplers. Other responsibilities included method development, equipment installation, and standard preparation.

ASTI LABORATORY, INC. (Oct. 1988-Oct. 1989)

Ann Arbor, MI

Responsible for start-up of organic section of laboratory which included: equipment and supply purchasing; installation; calibration; and trouble shooting. Operation of Varian 3400 GC with Hall, PID, FID, and ECD detectors; Tekmar LSC 2000 Purge and Trap; Varian DS-654 Data System. Analyses performed to EPA SW-846 methodologies.

Raytheon Service Company (May 1986-Sept. 1988)

Grosse Ile, MI

Analytical responsibilities included capillary GC analysis of environmental samples from the Great Lakes and its tributaries. Operation of Varian GC 3700, 3600; HP Data System with LAS software. Performed extensive clean-up procedures on environmental samples including GPC, Florisil, and Silica gel.

U.S. Environmental Protection Agency (April 1983-April 1985)

Grosse Ile, MI

Analytical responsibilities included soxhlet and liquid/liquid solvent extractions on water, soil and biota samples. Acute static toxicity testing using Ceriodaphnia and Pimephales; seven day renewal method.

DAVID J. BROKAW
PROGRAM MANAGER

**SPECIAL
SKILLS**

Experienced in the operation and maintenance of the Varian 3400, 3600, 3700, VISTA and Tracor 540 GC's; Varian 8034, 8035, 8100, and 8200 autosamplers; Detectors: PID, ELCD, ECD, FID, and TSD. Qualified to perform EPA SW-846 methods; 8010, 8020, 8015 (ROH), 8040, 8080, 8140, 8150 and CLP 3/90 SOW (OLM01.8). Experienced in the use of LOTUS 123, QUATROPRO, EXCEL, WORDPERFECT, WINDOWS, and PE Nelson model 2600 chromatography software.

**SPECIAL
TRAINING**

Short Course on 'Managing Multiple Projects, Objectives and Deadlines'
SkillPath Seminars, December 1993

Short Course on 'Capillary Gas Chromatography: Techniques and Problem Solving', American Chemical Society. October 1987

Short Course on 'Quality Assurance of Chemical Measurements',
American Chemical Society. December 1985

OSHA 40-hour HAZWOPER- Site Operations certification, June 1996

OSHA Laboratory Safety Training, November, 1996

JUDY V. HARRY
P. O. Box 208
Cobble Creek Rd.
North Creek, NY 12853

Occupation: Data Validator/Environmental Technical Consultant

Years Experience: 21

Education: B.S., Chemistry, Magna cum laude, 1976, Phi Beta Kappa

Certifications: New York State Woman-Owned Business Enterprise (WBE)

Relevant Work History:

Data Validation Services: September 1989 - present

Sole proprietor of Data Validation Services, providing validation services to various clients. These services include the review of analytical laboratory data for compliance with respect to various protocols, accuracy and defensibility of data, verification of reported values, and evaluation of quality parameters for analytical usability of results. Approved by NYSDEC and NYCDEP as a data validator for projects contracted through the Division of Hazardous Waste. Validator for USEPA Superfund and lead sites.

Performed validation for compliance with protocols including 12/91 NYSDEC ASP, 1989 NYSDEC ASP, 1987 NYSDEC CLP, USEPA OLM, USEPA OLC, USEPA ILM, USEPA DFLM, USEPA SOW3/90, USEPA SOW 7/87 CLP, USEPA SOW 2/88 CLP, USEPA SW846, RCRA, AFCEE, Part 360, 40 CFR, and Air analysis methods. Performed validation according to the NYSDEC Validation Scope of Work, USEPA National and Regional Functional Guidelines, USEPA Region II HW SOPs, AFCEE, and NJDEPE Division of Hazardous Site Mitigation/Publicly Funded Site Remediation SOPs.

Performed validation for USEPA Superfund Sites including Salem Acres, York Oil, and OTIS AFB; and for USEPA lead sites including SJ&J Piconne, Maska, Bowe System, Syossett Landfill, and Port Washington L-4 Landfill, involving CLP, RAS, and SAS protocols.

Contracted for NYSDEC Superfund Standby Contracts with LMS Engineers, Camp Dresser & McKee, Malcolm-Pirnie, and EC Jordan, involving samples collected at NYS Superfund Sites and analysed under the 12/91 NYSDEC ASP.

Validated data for NYSDEC Phase II remedial investigations, RI/FS projects, and PRP oversight projects for hazardous waste sites. Was the primary contractor for Lawler, Matusky & Skelly Engineers during fifth and sixth round Phase II investigation, reviewing results for TCL/TAL analyses performed according to EPA CLP and 1989 NYSDEC ASP. Provided data validation for Phase II investigations for Gibbs & Hill, Inc, reviewing results from TCL/TAL analyses performed according to 1989 NYSDEC ASP.

Performed validation services for clients conducting RI/FS activities involving samples of many matrices, including waste, air, sludges, leachates, solids/sediments, aqueous, and biota; clients have included Barton & Loguidice, Blasland Bouck & Lee, Camp Dresser & McKee, Ecology & Environment, EC Jordan, Engineering-Science, Fanning Phillips & Molnar, Groundwater Technology, H2M Group, Lockwood, Kessler & Bartlett, LMS Engineers, Malcolm-Pirnie, O'Brien & Gere, Rizzo Associates, Roux Associates, URS Consultants, Wehran Emcon, Weston, YEC.

Validated sample data pertaining to numerous landfill site investigations for TCL/TAL and Part 360 analytes.

Validated data for NYSDEC and NJDEPE sites for samples analysed according to EPA CLP SOPs, with validation performed according to NJDEPE validation procedures.

Provided consultation services to laboratories regarding analytical procedures and protocol interpretation, and to law firms for litigation support.

Provided services to firms involving audits of environmental analytical laboratories to determine analytical capability, particularly for compliance with 12/91 NYSDEC ASP requirements.

Guest speaker on a panel discussing Data Review/Compliance and Usability, for an analysts workshop for the New York Association of Approved Environmental Laboratories, 1993.

Adirondack Environmental Services: June 1987 - August 1989

Senior mass spectroscopist for AES. Responsible for GC/MS analyses of environmental samples; development of the GC/MS laboratory, initiating the instrumental and computer operations from the point of installation; and for implementing the procedures and methodologies for Contract Laboratory Protocol.

CompuChem Laboratories: May 1982 - January 1987

Managed a GC/MS laboratory; developed, implemented, and supervised QA/QC criteria at three different levels for review; and was responsible for the development and production of environmental and clinical samples. Directed a staff of 23 technical and clerical personnel, and managed the extraction, GC/MS, and data review labs.

Research Triangle Institute: December 1979 - May 1982

Worked as an analytical research chemist responsible for development of analytical methods for the EPA Federal Register at RTI. This involved analysis of biological and environmental samples for priority pollutants, primarily relating to wastewaters and to human sampling studies. Method development included modification and interfacing of volatile purge apparatus to GC/MS, analysis and resolution/identification of individual PCB congeners by capillary column by mass spectra.

Guardsman Chemical Company: February 1977 - November 1979

Performed all quality control functions for the manufacturing plant. Performed research and development on coatings and dyes.

Almay Cosmetics: May 1976 - December 1976

Product evaluation chemist. Responsible for analytical QC of manufactured products.

Data Validation Services

STATEMENT OF QUALIFICATIONS

Data Validation Services offers independent evaluation and validation of analytical data generated by environmental laboratories utilizing NYSDEC or EPA protocols.

Data Validation Services has been certified by the New York State Governor's Office of Woman and Minority Business Development as a Woman-Owned Business Enterprise (WBE). The validator for Data Validation Services, Judy Harry, exceeds all NYSDEC qualifications and requirements for performing the review functions as outlined in the NYSDEC RI/FS Program. She has also been approved for validation of numerous USEPA lead sites. A summary of her qualifications is as follows:

- 1) Sole Proprietor of Data Validation Services since start-up in September, 1989, completing project/contract review of data generated from methodologies of 1989/1991/1995 NYSDEC ASP; 1987 NYSDEC CLP; USEPA CLP ILMxx, OLMxx, DFLM0x.x, SOW 787, SOW 288, USEPA SW846, RCRA, Part 360, USEPA Federal Registry, and the Compendium Ambient Air methods.
- 2) Validation is available utilizing NYSDEC RI/FS Validation Scope of Work, USEPA Functional Guidelines (national and regional), USEPA Region II Validation SOPs, AFCEE, and NJDEP QA Validation procedures.
- 3) Eight years of experience in independent validation of environmental analytical data. Thirteen years of experience as an environmental laboratory chemist, with ten years specifically in the field of Mass Spectrometry. Experience includes development of many of the methods currently utilized for environmental analysis.
- 4) Consultation services for laboratory or engineering firms provided, developed and enhanced from extensive laboratory background and method familiarity.
- 5) B.S. in Chemistry, 1976, magna cum laude, University of North Carolina at Greensboro.
- 6) Development of EPA Federal Register protocols for analysis of Priority Pollutants in wastewaters and sludges (Research Triangle Institute, NC).
- 7) Development of GC/MS capillary analyses of PCB congeners and of low level volatile organics. (RTI, NC)
- 8) Production Development Specialist, and Clinical GC/MS Lab Manager (CompuChem Labs, RTP, NC).
- 9) Developed GC/MS environmental laboratory, and instituted Contract Laboratory Protocol methodologies (Adirondack Environmental Services, Rensselaer, NY).
- 10) Completed courses in operation of mass spectral systems, interpretation of spectra, and supervision and management of laboratory and personnel.

Extensive analytical experience, as well as familiarity with protocol and laboratory operations, promotes efficiency and completeness in the review process. This enables Data Validation Services to produce quality work in a timely fashion.

Sample review reports and references are available upon request.



D

APPENDIX D
HACH IRON TEST KIT PROCEDURES

• Iron, Ferrous, Test Kit

0.0 – 10.0 mg/L

Mod. IR-18C

(1,10 Phenanthroline Iron Reagent Method)

26672-00

- To ensure accurate results, read carefully before processing.
- Pour obtenir des résultats exacts, lire attentivement le mode d'emploi avant d'utiliser la trousse.
- Um genaue Ergebnisse zu gewährleisten, lesen Sie das Folgende bitte aufmerksam durch, bevor Sie fortfahren.
- Para obtener resultados precisos lea detenidamente las instrucciones antes de proceder al análisis.

WARNING

Handling chemical samples, standards, and reagents can be dangerous. Review the Material Safety Data Sheets before handling any chemicals.

ATTENTION

La manipulation des échantillons chimiques, étalons et réactifs peut être dangereuse. Lire les fiches de données de sécurité des produits avant de manipuler tout produit chimique.

WARNUNG

Die Handhabung chemischer Proben, Standards und Reagenzien kann gefährlich sein. Bitte gehen Sie die Materialsicherheitsdatenblätter durch, bevor Sie Chemikalien handhaben.

ADVERTENCIA

El manejo de sustancias químicas, patrones y reactivos, puede resultar peligroso. Lea las Fichas de Informaciones de Seguridad de Materiales antes de manipular cualquier producto químico.



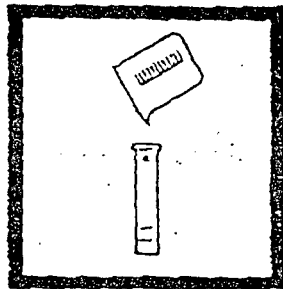
Introduction

- The 1,10 phenanthroline indicator in the Ferrous Iron Reagent reacts with ferrous iron in the sample to form an orange color in proportion to the iron concentration. Ferric iron does not react. The ferric iron (Fe^{3+}) concentration can be determined by subtracting the ferrous iron concentration from the results of a total iron test.

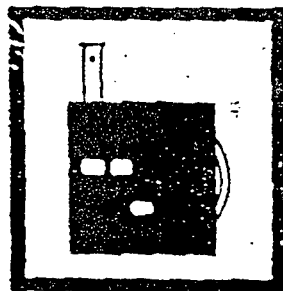
Measuring Hints and General Test Information

- Wash all labware between tests. Contamination may alter test results. Clean with a non-abrasive detergent or a solvent such as rubbing alcohol. Use a soft cloth for wiping or drying. Do not use paper towels or tissue on plastic tubes as this may scratch them. Rinse with clean water (preferably demineralized water).
- Rinse all viewing tubes thoroughly with the sample water before testing.
- Use clippers to open plastic powder pillows.
- Hach strongly recommends that, for optimum test results, reagent accuracy be checked with each new lot of reagents. Prepare a ferrous iron stock solution (100 mg/L Fe) by dissolving 0.7022 grams of ferrous ammonium sulfate, hexahydrate in deionized water. Dilute 5.00 mL of this solution to 100 mL with demineralized water to make a 5.0 mg/L standard solution. Prepare this immediately before use. Follow the ferrous iron test instructions using this solution instead of a water sample.

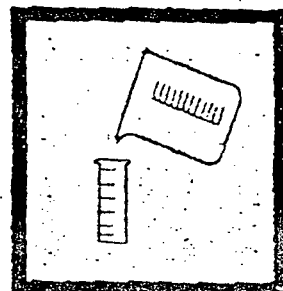
• Procedure



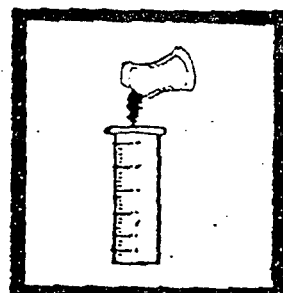
1. Fill a viewing tube to the first (5-mL) line with sample water. This is the blank.



2. Place this tube in the top left opening of the color comparator.



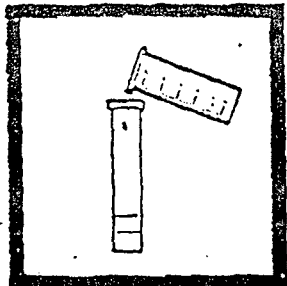
3. Fill the measuring vial to the 25-mL mark with sample water.



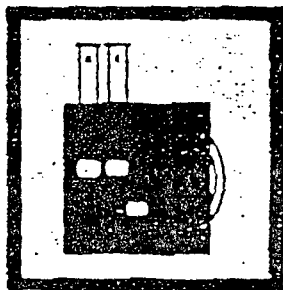
4. Add the contents of one Ferrous Iron Reagent Powder Pillow to the measuring vial.



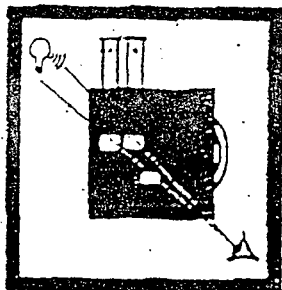
5. Swirl to mix. An orange color will develop if ferrous iron is present. Allow three minutes for full color development.



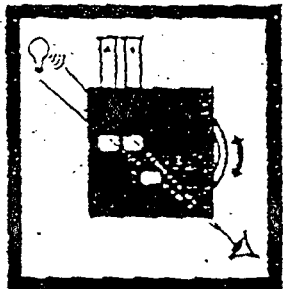
6. Fill another viewing tube to the first (5-mL) mark with the prepared sample.



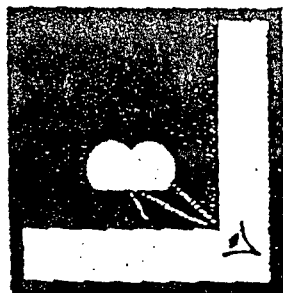
7. Place the second tube in the top right opening of the color comparator.



8. Hold comparator up to a light source such as the sky, a window or a lamp. Look through the openings in front.



9. Rotate the color disc until the color matches in the two openings.



10. Read the mg/L ferrous iron in the scale window.

REPLACEMENTS

Description	Unit	Cat. No.
Clippers	each	968-00
Color Comparator	each	1732-00
Color Disc, Iron Phenanthroline	each	1874-00
Ferrous Ammonium Sulfate, Hexahydrate	113 g	11256-14
Ferrous Iron Reagent Powder Pillows, 25 mL	100/pkg	1037-69
Vial, measuring, with 2, 5, 10, 15, 20 and 25 mL marks	each	2193-00
Viewing Tube, Plastic	4/pkg	46600-04
Water, Demineralized	4 L	272-56



E

APPENDIX E

STANDARD OPERATING PROCEDURE, QUALITY ASSURANCE/QUALITY CONTROL PROCEDURES

(FOR INTERNAL USE ONLY)
STANDARD OPERATING PROCEDURE
FOR FIELD RECORD KEEPING AND
QUALITY ASSURANCE/QUALITY CONTROL

Page 1 of 4

Date: May 15, 1990

Revision Number: 0

Corporate QA/QC Manager: *Unsigned Copy*

1.0 PURPOSE

The purpose of this standard operating procedure (SOP) is to provide procedures and standards for record keeping and maintenance, for all field activities conducted by Roux Associates, Inc. (Roux Associates).

Strict quality assurance/quality control (QA/QC) is necessary to properly and accurately document and preserve all project-related information. Quality assurance is implemented to corroborate that quality control procedures are followed. Quality control provides a means to monitor investigation activities (e.g., sampling and laboratory performance) as a check on the quality of the data.

Valid data and information are integral to all aspects of Roux Associates' field activities. These aspects include, but are not necessarily limited to, activities that involve: drilling; sediment, sludge, and soil sampling (lithologic, and soil-quality and analysis); well construction and development; aquifer testing and analysis; water-quality sampling and analysis (surface water and ground water); free-product sampling and analysis; air-quality sampling and analysis; geophysical testing; demolition activities; waste removal operations; engineering installations; etc. The data will be confirmed by QA/QC methods established and set forth in the work plan/scope of work. Without checks on the field and analytical procedures, the potential exists for contradictory results, and associated incomplete or incorrect results from the interpretation of potentially questionable data.

Documentation will be entered in the field notebook and must be transcribed with extreme care, in a clear and concise manner, as the information recorded will become part of the permanent legal record. Because field notes are the legal record of site activities, they must be taken in a standard and consistent manner. If abbreviations are used, then they must first be spelled out for clarity (i.e., to avoid ambiguity and misunderstanding). All entries must be dated and initialed, and the time (military time) of the entry included. Field notebooks and forms must be assigned to an individual project and properly identified (i.e., client name, project number, location and name of site, individual recording information, dates, times, etc.). Change of possession of field notebooks or forms must be documented with the date and time, and initialed by both individuals. Following each day's entries, the field notebook or form must be photocopied in the event that the original documentation is lost or stolen. All field notebooks must have the company name and address legibly printed in indelible ink along with the message "If found, then please forward to Roux Associates, Inc. at the above address - REWARD OFFERED."

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STANDARD OPERATING PROCEDURE
FOR FIELD RECORD KEEPING AND
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Information must be recorded while onsite because it may be difficult to recall details at a later date. Furthermore, information must be documented immediately as it provides unbiased information which will be used for writing the report when the field activities are completed. Project-related documentation is an irreplaceable, important record for other individuals who may become involved in the project, and provides the project manager with a complete history of project-related activities. Written information must be accompanied by maps, sketches, and photographs where appropriate, especially if these supplemental sources of information assist in the documentation process. A new page must be used in the field notebook for each new day's entries (i.e., unused portions of a previous page must have an "X" placed through it). The end of the day's records must be initialed and dated.

As part of record keeping and QA/QC activities, state and federal regulatory agencies should be contacted to check if special or different protocols are required and/or if particular or unconventional methods are required for the given field activity. Thus, the record keeping and QA/QC activities implemented by Roux Associates are based on technically sound standard practices and incorporate Roux Associates own, extensive experience in conducting hydrogeologic field activities.

2.0 MATERIALS

In order to track investigation activities, specific materials are required. These materials include the following:

- a. A bound, waterproof field notebook.
- b. Appropriate Roux Associates' forms (e.g., daily log, geologic log, monitoring well construction log, well sampling data form, location sketch, chain of custody, telephone conversation record, meeting notes, etc.).
- c. Appropriate labels (e.g., sample, Roux Associates' Custody Seal, etc.)
- d. Work plan/scope of work.
- e. Health and safety plan (HASP).
- f. Appropriate Roux Associates' SOPs.
- g. Black pens, and indelible markers.
- h. Camera and film.

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STANDARD OPERATING PROCEDURE
FOR FIELD RECORD KEEPING AND
QUALITY ASSURANCE/QUALITY CONTROL

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3.0 DOCUMENTATION

- 3.1 Before the Roux Associates personnel leave the field, they must ensure that their field notes include comprehensive descriptions of the hydrogeologic conditions, and all investigation-related activities and results (onsite and offsite). This will safeguard against the inability to reconstruct and comprehend all aspects of the field investigation after its completion, and will serve to facilitate the writing of an accurate report. Properly documented information provides the QA/QC tracking (back-up) required for all Roux Associates' projects. General types of information that must be recorded (where pertinent to the investigation being conducted) include, but may not necessarily be limited to, the following:
- a. List of Roux Associates personnel onsite.
 - b. Name, date, and time of arrival onsite by Roux Associates personnel, including temporary departures from, and returns to, the site during the work day.
 - c. Client and project number.
 - d. Name and location of study area.
 - e. Date and time of arrival onsite by non-Roux Associates personnel (names and affiliation) and equipment (e.g., subcontractors and facility personnel, and drilling equipment, respectively, etc.), including temporary departures from, and returns to, the site during the work day, and departure at the end of the work day.
 - f. List of non-Roux Associates personnel onsite.
 - g. Weather conditions at the beginning of the day as well as any changes in weather that occur during the working day.
 - h. Health and safety procedures including level of protection, monitoring of vital signs, frequency of air monitoring, and any change (i.e., downgrade or upgrade) in the level of protection for Roux Associates and other on-site personnel (e.g., subcontractors, facility personnel, etc.).
 - i. Health and safety procedures not in compliance with the HASP (for all on-site personnel).
 - j. Site reconnaissance information (e.g., topographic features, geologic features, surface-water bodies, seeps, areas of apparent contamination, facility/plant structures, etc.).
 - k. Air monitoring results (i.e., photoionization detector [PID], etc. measurements).

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(FOR INTERNAL USE ONLY)
STANDARD OPERATING PROCEDURE
FOR FIELD RECORD KEEPING AND
QUALITY ASSURANCE/QUALITY CONTROL

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- l. Task designation and work progress.
 - m. Work-related and site-related discussions with subcontractors, regulatory agency personnel, plant personnel, the general public, and Roux Associates personnel.
 - n. Delays, unusual situations, problems and accidents.
 - o. Field work not conducted in accordance with the work plan/scope of work, and rationale and justification for any change(s) in field procedures including discussions with personnel regarding the change(s) and who authorized the change(s).
 - p. QA/QC procedures not conducted in accordance with the QA/QC procedures established in the work plan/scope of work and rationale and justification for any change(s) in QA/QC procedures including discussions with personnel regarding the change(s) and who authorized the change(s).
 - q. Equipment and instrument problems.
 - r. Decontamination and calibration procedures.
 - s. Activities in and around the site and work area by any and all on-site personnel which may impact field activities.
 - t. Sketches, maps, and/or photographs (with dates and times) of the site, structures, equipment, etc. that would facilitate explanations of site conditions.
 - u. Contamination evidenced as a result of work-related activities (e.g., visible contaminants [sheen] in drilling fluids or on drilling equipment; sheen on, or staining of, sediments; color of, or separate [nonaqueous] phase on, water from borehole or well; vapors or odors emanating from a borehole or well; etc.); make all observations as objectively as possible (e.g., grey-blue, oil-like sheen; black and orange, rust-like stain; fuel-like odor; etc.) and avoid using nontechnical or negative-sounding terms (e.g., slimy, goopy, foul-smelling).
 - v. Date and time of final departure from the site of all personnel at the end of the work day.
- 3.2 In addition to the general types of information that must be recorded (as presented in Section 3.1), task-specific information must also be properly documented. Task-specific information which is required is provided in each respective task-oriented SOP, and the documentation procedures outlined in each SOP must be followed.

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F

APPENDIX F

STANDARD OPERATING PROCEDURE, EVALUATION AND VALIDATION OF DATA

(FOR INTERNAL USE ONLY)
STANDARD OPERATING PROCEDURE
FOR EVALUATION AND VALIDATION OF DATA

Page 1 of 4

Date: May 15, 1990

Revision Number: 0

Corporate QA/QC Manager: *Unsigned Copy*

1.0 PURPOSE

The purpose of this standard operating procedure (SOP) is to establish the criteria to be followed for the evaluation of data quality and for data validation. Because valid media-quality data are integral to environmental investigations that characterize site conditions, the quality of the data generated by a laboratory is extremely important to the successful completion of a project. The level of data evaluation and validation required is determined by the project data quality objectives and must be outlined in the work plan/scope of work. Data collected to establish qualitative trends, for example, do not require the same level of validation as data generated to support litigation.

The data evaluation procedure described in Section 2.0 of this SOP is designed to provide a measure of comparability regarding quality control (QC) samples, i.e., between duplicate or replicate samples and to detect any contamination or bias in analyses of blanks. They may be used for both intra-laboratory and inter-laboratory comparisons.

The data validation procedure described in Section 3.0 of this SOP is designed to provide a stringent review of analytical chemical data with respect to sample receipt and handling, analytical methods used, and data reporting and deliverables.

Prior to performing any data evaluation or validation, it is crucial that all appropriate regulatory agencies be contacted and their data validation requirements be determined, as these requirements vary from agency to agency and may vary among different Regions of the United States Environmental Protection Agency (USEPA).

2.0 PROCEDURE FOR EVALUATION OF DATA

2.1 Not all analytical data packages will require a full data validation procedure as described in Section 3.0. The procedures described in this section provide an initial screening to help decide if full data validation is warranted. These data evaluation procedures are used as a quality assurance (QA) check for water-quality data, and are not generally applicable to soil-quality data. They are to be used when a full data validation procedure (described in Section 3.0) is not required.

2.2 Primary/Replicate, Primary Split and Primary/Laboratory Duplicate Comparisons

X = primary sample concentration

Y = replicate/split/laboratory duplicate sample concentration

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STANDARD OPERATING PROCEDURE
FOR EVALUATION AND VALIDATION OF DATA

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$$Z = \{(X-Y)/[(X+Y)/2]\} \times 100$$

IDC = initial concentration requiring dilution, if samples have been diluted. If samples did not require dilution, then use the first range (i.e., QL-10[QL]).

QL = Quantitation Limit⁽¹⁾

Organic Constituents

<u>Range</u>	<u>Quantitative</u>	<u>Qualitative</u>	<u>Unusable</u>
QL - 10(QL)	$Z \leq 60\%$	$100\% > Z > 60\%$	$Z \geq 100\%$
10(QL) - IDC	$Z \leq 40\%$	$100\% > Z > 40\%$	$Z \geq 100\%$
X or Y > IDC	$Z \leq 60\%$	$100\% > Z > 60\%$	$Z \geq 100\%$

Inorganic Constituents

<u>Analytical Method</u>	<u>Quantitative</u>	<u>Qualitative</u>	<u>Unusable</u>
Wet Chemistry testing	$Z \leq 60\%$	$100\% > Z > 60\%$	$Z \geq 100\%$
Atomic Absorption (AA)	$Z \leq 40\%$	$100\% > Z > 40\%$	$Z \geq 100\%$
Inductively Coupled Plasma (ICP)	$Z \leq 40\%$	$100\% > Z > 40\%$	$Z \geq 100\%$

2.3 Comparison of Blanks

X = primary sample concentration⁽²⁾

D = highest concentration in associated blank(s)

Y = X/dilution factor

	<u>Quantitative</u>	<u>Qualitative</u>	<u>Unusable</u>
Field Blank	$D \leq 0.1X$	$0.5X > D > 0.1X$	$D \geq 0.5X$
Trip Blank	$D \leq 0.1X$	$0.5X > D > 0.1X$	$D \geq 0.5X$
Lab Blank	$D \leq 0.1Y$	$0.5Y > D > 0.1Y$	$D \geq 0.5Y$

⁽¹⁾ The quantitation limit will be dependent upon the specific methodology and the matrix, and will be either the minimum detection limit (MDL) or the practical quantitation limit (PQL).

⁽²⁾ Results reported as BDL (below the detection limit) will be considered Quantitative because the primary samples have not been affected by the bias(es) which resulted in concentrations reported in the blank sample(s).

3.0 PROCEDURE FOR DATA VALIDATION

- 3.1 Determine study-specific data quality needs and pertinent regulatory agency data validation requirements.
- 3.2 Contact the appropriate regulatory agency(ies) to obtain their data validation procedure manual. This manual will indicate acceptable ranges for QC parameters to be investigated and procedures to follow for data which do not meet these requirements.
- 3.3 For inorganic compounds, the requirements that will be examined during the validation process are:
 - a. Holding times.
 - b. Instrument calibration, including initial and continuing calibration verification.
 - c. Blank(s).
 - d. Laboratory control sample(s).
 - e. Inductively Coupled Plasma (ICP) interference check samples.
 - f. Duplicate sample(s).
 - g. Matrix spike sample(s).
 - h. Furnace atomic absorption QC.
 - i. ICP serial dilution(s).
 - j. Sample result verifications.
 - k. Field duplicates.
 - l. General data assessment.
- 3.4 For organic compounds, the requirements that will be examined during the validation process are:
 - a. Holding times.
 - b. Gas Chromatograph/Mass Spectrometer (GC/MS) tuning.
 - c. GC calibration, initial and continuing.
 - d. Blanks.

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- e. Surrogate recoveries.
 - f. Matrix spike/matrix spike duplicates.
 - g. Internal standards performances.
 - h. Target Compounds List (TCL) compound identifications.
 - i. Reported detection limits.
 - j. Tentatively identified compounds (TICs).
 - k. Overall system performance.
 - l. General data assessment.
- 3.5 The parameters which do not conform to requirements are then listed and the data are qualified according to the guidelines provided in the appropriate regulatory agency's data validation procedure manual. The qualified data package is then reviewed and the project data reviewer, the project geochemist and/or the project manager makes a professional judgement concerning the validity of the data package, and its usability for the project.

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G

APPENDIX G
FIELD CHANGE REQUEST FORM

Project/Task Number: _____
 Procedure Reference: _____
 Requested Modification: _____

Reason for Modification: _____

Special Equipment, Material or Personnel Required: _____

Modification Requested By: _____ Date: _____

Approved By: _____ Date: _____

Title: _____

Comments: _____